Carrier
TRANSICOLD

Bus Air Conditioning Unit

Model 68RF50 NEOPLAN-LA

OPERATION AND SERVICE

T-271

Carrier
TRANSICOLD

OPERATION AND SERVICE MANUAL

BUS AIR CONDITIONING UNIT

MODEL 68RF50 NEOPLAN-LA

UNITED TECHNOLOGIES CARRIER TRANSICOLD

Carrier Transicold Division, Carrier Corporation, P.O. Box 4805, Syracuse, N.Y. 13221

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SECTION 1

DESCRIPTION

1.1 INTRODUCTION

This manual contains operating data, electrical data, and service instructions for the 68RF50 NEOPLAN-LA air conditioning, heating and ventilation systems shown in the model chart below.

The 68RF50 units are two piece systems consisting of condenser and evaporator assemblies. The units are installed on the roof of the bus. These units interface with the bus' compressor, floor heater, and pump to provide a full air conditioning, heating and ventilation system.

The 68RF50 units are equipped with R-134a refrigerant.

All control systems are powered by 24-vdc supplied by the bus battery and alternator or alternate source.

Operation of the 68RF50 units is controlled automatically by the temperature controller which maintains the vehicles interior temperature at the desired setpoint.

The units are equipped with a reheat/cycling clutch switch to give the operator the option between cooling control actions. In the cycling clutch control operation, the compressor cycles on and off to control vehicle interior temperature. When the switch is in REHEAT position, the coolant valve opens and closes on thermostat command to control vehicle interior temperature while the air conditioning mode continues to operate.

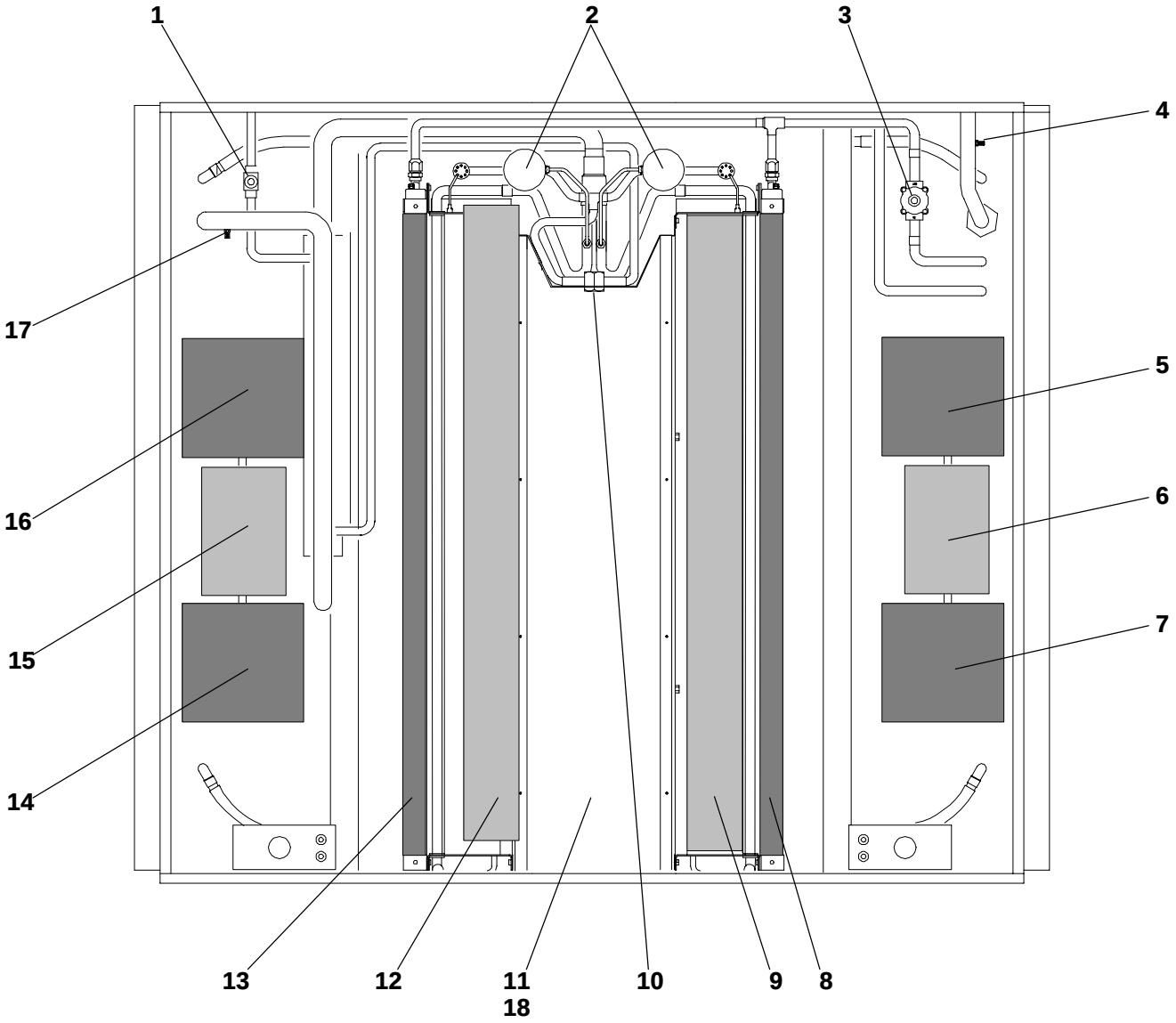
Table 1-2 shows additional manuals available for servicing the 68RF50 units.

Table 1-1. Model Chart

MODEL	SERIES	DESCRIPTION
68RF50 NEOPLAN-LA	Roof Mounted	Three Condenser Fan

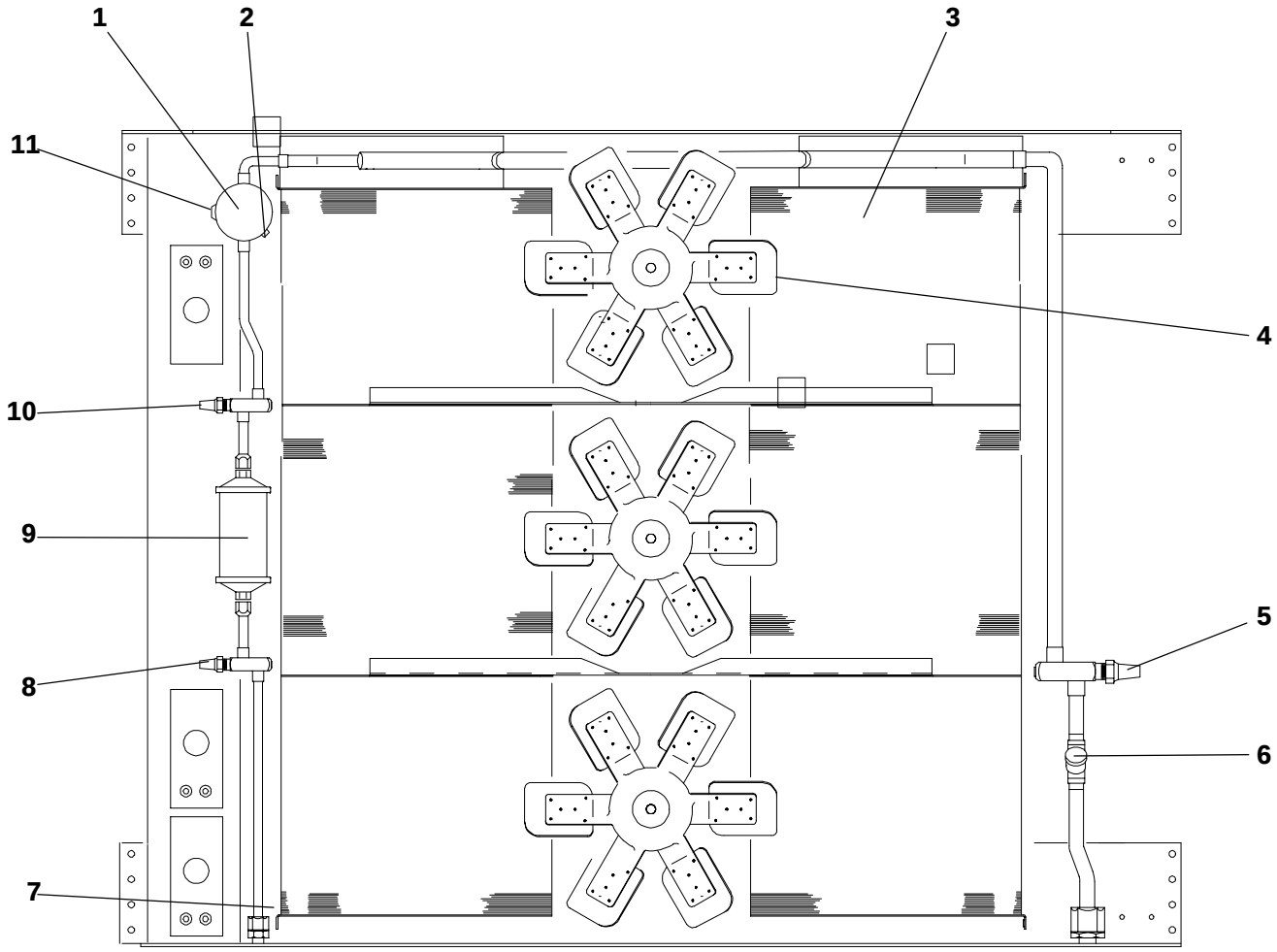
Table 1-2. Additional Support Manuals

MANUAL/FORM NO.	EQUIPMENT COVERED	TYPE OF MANUAL
T-199	05G Bus Compressor	Operation and Service
T-200	05G Bus Compressor	Parts List



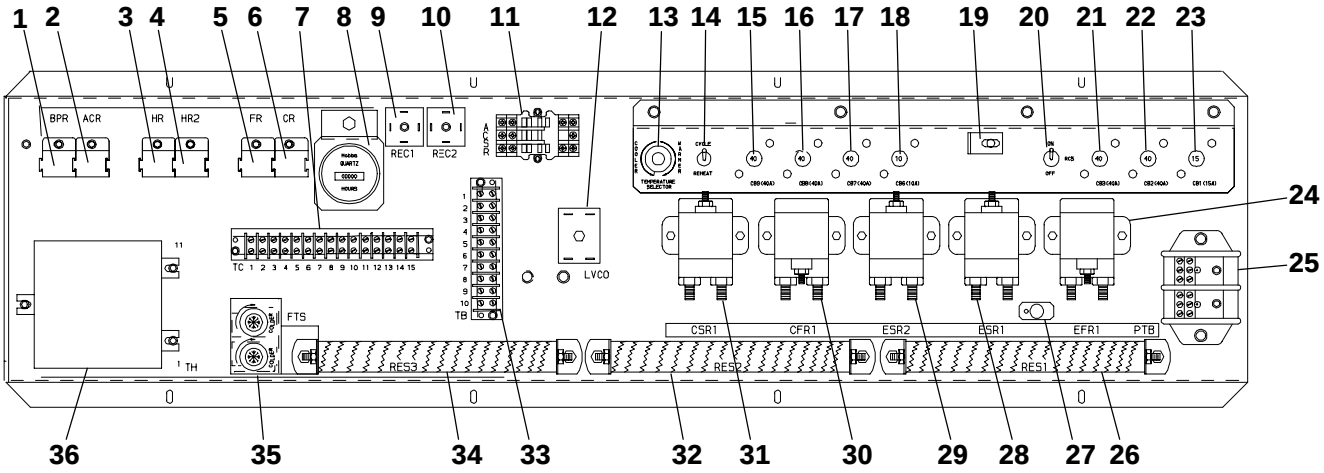
1. Liquid Line Solenoid Valve
2. Thermal Expansion Valves
3. Hot Water Valve
4. Condenser Fan Switch
5. Evaporator Blower
6. Evaporator Blower Motor
7. Evaporator Blower
8. Heater Coil
9. Evaporator Coil
10. Sight Glass
11. Return Air Opening
12. Evaporator Coil
13. Heater Coil
14. Evaporator Blower
15. Evaporator Blower Motor
16. Evaporator Blower
17. Unloader Pressure Switch
18. Electrical Control Panel (See Figure 1-3.)

Figure 1-1. Evaporator Assembly – Top View



1. Receiver
2. Fusible Plug
3. Condenser Coil
4. Condenser Fan and Motor
5. Discharge Line Valve
6. Discharge Check Valve
7. Ambient Air Switch
8. Filter-Drier Outlet Valve
9. Filter-Drier
10. Receiver Outlet or Filter-Drier Inlet Valve
11. Sight Glass

Figure 1-2. Condenser Assembly – Top View



1. Booster Pump Relay (BPR)
2. A/C Relay (ACR)
3. Heat Relay (HR)
4. Heat Relay #2 (HR2)
5. Fault Relay (FR)
6. Clutch Relay (CR)
7. Terminal Block “C” (TC)
8. Hourmeter (ACHM)
9. Rectifier #1 (REC1)
10. Rectifier #2 (REC2)
11. A/C Stop Relay (ACSR)
12. Low Voltage Cutout Device (LVCO)
13. Temperature Selector
14. Reheat/Cycle Switch (RHCS)
15. Circuit Breaker (CB9) – 40 Amp
16. Circuit Breaker (CB8) – 40 Amp
17. Circuit Breaker (CB7) – 40 Amp
18. Circuit Breaker (CB6) – 10 Amp
19. Temperature Sensor
20. Run Control Switch #1 (RCS1)
21. Circuit Breaker (CB3) – 40 Amp
22. Circuit Breaker (CB2) – 40 Amp
23. Circuit Breaker (CB1) – 15 Amp
24. Evaporator Fan Relay #1 (EFR1)
25. Power Terminal Block (PTB)
26. Resistor #1 – Evaporator (RES1)
27. Run Control Switch #2 (RCS2)
28. Evaporator Speed Relay #1 (ESR1)
29. Evaporator Speed Relay #2 (ESR2)
30. Condenser Fan Relay #1 (CFR1)
31. Condenser Speed Relay #1 (CSR1)
32. Resistor #2 – Evaporator (RES2)
33. Terminal Block “B” (TB)
34. Resistor #3 – Condenser (RES3)
35. Freeze Thermostat Switch (FTS)
36. Thermostat Controller (TH)

Figure 1-3. Electrical Control Panel Components for Models with Rotron Brushless Motors

1.2 REFRIGERATION SYSTEM COMPONENT SPECIFICATIONS

a. Refrigeration Charge

R-134a: 16 lb. *(7.3 kg)*

b. Compressor

Model: 05G
No. of Cylinder: 6
Weight (Dry): 165 lbs. *(75 kg)*, including clutch
Oil Charge: 6.75 pints (3.2 liters)
Oil Level:
Old Crankcase (before S/N 4994J):
Bottom to 1/4 of sight glass
New Crankcase (beginning S/N 4994J):
Between Min–Max marks on crankcase
Approved Compressor Oils:
R-134a Unit:

Castrol:	Icematic SW68C
Mobil:	EAL Artic 68
ICI:	Emkarate RL68H

c. Thermostatic Expansion Valve

R-134a TXV:

Superheat Setting:	6_F (-14.4_ C) to 16_F (-8.9_C), at 40_F (4.4_C) evap. temp.
MOP Setting:	53.9 ±4 psig *(3.8 ±0.28 kg/cm@)*

d. Low Pressure Switch (LPS)

R-134a Unit:

Opens at:	10 ±3 psig *(0.70 ±0.21 kg/cm@)*
Closes at:	25 ±3 psig *(1.8 ±0.21 kg/cm@)*

e. High Pressure Switch (HPS)

R-134a:

Opens at:	425 ±10 psig (30 ±0.7 kg/cm@)
Closes at:	300 ± 10 psig (21 ±0.7 kg/cm@)

f. Unloader Pressure Switch #2 (UPS2)

R-134a Unit:

Opens at:	40 ± 5 psig *(2.8 ±0.35 kg/cm@)*
Closes at:	23 ±3 psig *(1.6 ±0.21 kg/cm@)*

g. Condenser Fan Speed Switch (CFS)

R-134a Unit:

Opens for high speed:	250 ±10 psig *(17.6 ±0.7 kg/cm@)*
Closes for low speed:	190 ±15 psig *(13.4 ±1 kg/cm@)*

h. Low Ambient Switch (LATH)

Opens at:	45 ±5_F *(7.2±0.35_C)*
Closes at:	55 ±5_F *(12.8 ±0.35_C)*

i. Reheat Coolant Valve

Coil Voltage	24- vdc
MOPD:	35
Capacity:	10-GPM @ 3 psig ΔP

1.3 ELECTRICAL SPECIFICATIONS

a. Evaporator Blower Motor

Evaporator Motor	Brushless
Bearing Lubrication	Factory Lubricated (additional grease not required)
Horsepower	0.6
Full Load Amps (FLA)	20
Operating Speed (RPM)	2200
Voltage	27-vdc
Dropping Resistor	0.6-ohms 300-watts

b. Condenser Fan Motor

Condenser Motor	Brushless
Bearing Lubrication	Factory Lubricated (additional grease not required)
Horsepower	0.6
Full Load Amps (FLA)	19
Operating Speed (RPM)	1800
Voltage	27-vdc
Dropping Resistor	0.25-ohms 300-watts

1.4 SAFETY DEVICES

Safety devices protect system components from damage caused by unsafe operating conditions.

If the High Pressure Switch (HPS) or Low Pressure Switch (LPS) opens due to unsafe operating conditions, the A/C operation will automatically stop. The A/C stop light will illuminate to indicate an unsafe condition has occurred. The evaporator blower motors will continue to run to circulate air throughout the bus.

During any mode of operation (A/C, Vent or Heat), the evaporator or condenser motors will stop if excessive current draw is sensed by the circuit breakers. All circuit breakers, when opened, must be manually reset by depressing the breaker button.

When the High Pressure Switch (HPS) or Low Pressure Switch (LPS) opens and unit operation stops, place the driver's A/C switch to the OFF position and back to the ON position to reset the A/C Stop Relay and de-energize the stop light.

Table 1-3. Safety Devices

Unsafe Condition	Safety Device	Device Setting
1. Excessive current draw by the boost pump motor.	Circuit Breaker – CB1 Manual Reset	Opens at 15 amps
2. Excessive current draw by evaporator blower motor no. 2.	Circuit Breaker – CB2 Manual Reset	Opens at 40 amps
3. Excessive current draw by evaporator blower motor no.1.	Circuit Breaker – CB3 Manual Reset	Opens at 40 amps
4. Excessive current draw by clutch.	Circuit Breaker – CB6 Manual Reset	Opens at 10 amps
5. Excessive current draw by condenser motor no.1.	Circuit Breaker – CB7 Manual Reset	Opens at 40 amps
6. Excessive current draw by condenser motor no. 2.	Circuit Breaker – CB8 Manual Reset	Opens at 40 amps
7. Excessive current draw by condenser motor no. 3.	Circuit Breaker – CB9 Manual Reset	Opens at 40 amps
8. High system pressure.	High Pressure Switch (HPS) Automatic reset	Opens at 425 ±10 psig *(30 ±0.7 kg/cm@)*
9. Low system pressure	Low Pressure Switch (LPS) Automatic Reset	Opens at 10 ±3 psig *(0.70 ±0.21 kg/cm@)*

1.5 SYSTEM OPERATING CONTROLS AND COMPONENTS

a. Temperature Controller (Thermostat)

The Temperature Controller is a thermostat that senses and controls the vehicle interior air temperature.

The desired interior temperature, setpoint of the controller is manually set with the temperature selector which is located in the electrical control panel. (See Figure 1-3.) The controller's temperature sensor monitors the bus' interior temperature at the return air section of the unit and controls the operating function of the system to maintain setpoint.

The controller regulates the operation cycles of the unit with four interior relays which activate the cool or heat and unloaded or loaded functions of the system relative to deviations from the thermostat setpoint. One relay controls the operation of Unloader Valve #1 (UV1). Another relay controls the function of Unloader Valve #2 (UV2). Another activates the cool cycle and another relay activates the heat cycle. Refer to Section 2 for description of operational control sequences for the various operational modes of operation.

b. Manual Switches

A/C Switch (ACS)

The A/C Switch (ACS) selects the Cooling (Air Conditioning) or Heating mode of operation. This switch is located on the driver's control panel. The switch is placed in the COOL position to energize A/C Relay (ACR) for cooling mode of operation and in the HEAT position to energize the Heat Relay (HR) for heating mode. In the COOL or HEAT position, and with the Run Control Switches (RCS1 and RCS2) in the ON position, 24-volts is also supplied to terminal board TC, terminal no. 8.

Reheat/Cycle Switch (RHCS)

The Reheat/Cycle Switch (RHCS) allows operator to select either reheat or cycling clutch control action. When placed in the CYCLING position, the unit cycles in the cooling mode of operation. When in the REHEAT position, unit cycles from cooling only mode to cooling with reheat mode.

Run Control Switch (RCS)

One Run Control Switch (RCS1) is located in the electrical control panel in the return air opening of the unit and the other (RCS2) is located on top of the electrical panel, which is accessed through the evaporator cover on the bus roof. These switches, when placed in the OFF position, will prevent the unit from starting when servicing the unit and when placed in the ON position, allows power to be applied to the Terminal Block (TC) for operation of the control system for heating, cooling or cooling with reheat modes of operation.

c. Thermal Switches

Low Ambient Thermostat (LATH)

The Low Ambient Thermostat (LATH) monitors the vehicles outside temperature. The switch opens a set of contacts at 45 ±5_F (7.2 ±0.35 _C) and closes at 55 ±5_F (12.8 ±0.35 _C). When the outside temperature is below the open setting of the switch, the switch opens the circuit to disengage the clutch and stop the compressor and stop the condenser fans.

d. Pressure Switches

Condenser Fan Speed Switch (CFS)

The Condenser Fan Speed Switch (CFS) senses refrigerant discharge pressure and control condenser fan speed. If refrigerant discharge pressure rises to the CFS cutout setting, the switch will open to de-energize the Condenser Speed Relay (CSR); this will close a set of normally closed CSR1 contacts and cause the Condenser Fan Motors (CM1, CM2 and CM3) to run at high speed. When the pressure drops to the CFS cut-in setting, the switch will close to energize CSR, which will open the CSR1 contacts and cause the Condenser Fan Motors (CM1, CM2 and CM3) to run at low speed. Refer to paragraph 1.2 for switch settings.

Unloader Pressure Switch #2(UPS2)

The Unloader Pressure Switch #2 (UPS2) controls unloader operation during the cooling mode of operation. The switch closes on a drop in evaporator suction pressure to energize Unloader Valve #1 (UV1). Energizing UV1 will place the compressor in four cylinder (semi-loaded) operation. As pressure rises, the switch will re-open. Refer to 1.2 for switch settings.

e. Relays

Fault Relay (FR)

The Fault Relay (FR) is located in the electrical control panel. The FR relay is energized during initial start-up, through the closed contacts of the High and Low Pressure Switches (HPS and LPS), to activate the cooling circuit components. If the High or Low Pressure Switch (HPS or LPS) opens during normal operation due to unsafe operating conditions, the Fault Relay (FR) will de-energize and open a set of normally open contacts to deactivate the cooling circuit control components. Another set of normally closed FR contacts will close to energize the relay A/C Stop Relay (ACSR), which closes a set of normally open contacts to light the stop light.

A/C Stop Relay (ACSR)

The A/C Stop Relay (ACSR) is located in the electrical control panel. The ACSR is a time delay relay which illuminates the stop light when energized by the Fault Relay (FR).

To restart the unit and turn the stop light off, the A/C Switch (ACS) must be toggled to OFF and then to COOL.

Clutch Relay (CR)

The Clutch Relay (CR) is located in the electrical control panel. When the CR relay is energized, a set of internal contacts will close to engage the compressor clutch (CL) to start the refrigerant cycle.

Air Conditioning Relay (ACR)

The Air Conditioning Relay (ACR) is located in the electrical control panel. The ACR relay is energized when the A/C Switch (ACS) is placed in the COOL position. When the ACR relay is energized, a set of normally open ACR contacts will close to allow the Clutch Relay (CR) and Condenser Fan Relay (CFR1) to energize. When de-energized, the ACR relay will prevent the clutch and condenser fans from being activated during the heating mode of operation.

Heat Relay (HR)

The Heat Relay (HR) is located in the electrical control panel. This relay will energize only when the A/C Switch (ACS) is in the HEAT position. When energized, a set of normally open HR contacts will close to allow the thermostat to control operation of the Boost Pump Relay (BPR) and Reheat Coolant Valve (RCV) during the heating mode. When the thermostat calls for heating, power is applied from thermostat plug J1, pin 1, through the closed HR contacts to energize the Boost Pump Relay (BPR) and Reheat Coolant Valve (RCV) and start the flow of engine coolant for heating.

Heat Relay #2 (HR2)

The Heat Relay #2 (HR2) is located in the electrical control panel. This relay is energized during the cooling cycle mode (when the thermostat is calling for cooling) and during the cooling with reheat mode (when the thermostat is calling for cooling only) to prevent the heating circuit from being energized while in cooling operation. The relay is de-energized during the cooling with reheat mode to activate the heating control circuit when the thermostat is not calling for cooling.

With the ACS switch in the COOL position and the RHCS switch in the CYCLE or REHEAT position, and when the thermostat calls for cooling, power is applied from the thermostat plug no. J1, pin no. 3, to energize Heat Relay #2 (HR2). Energizing relay HR2 opens a set of normally closed HR2 contacts to prevent activation of the heating control circuit while unit is in the cooling cycle mode.

With the ACS switch in the COOL position and the RHCS switch in the REHEAT position, and when the thermostat is not calling for cooling, power is removed from thermostat plug J1, pin no. 3, to de-energize Heat Relay #2 (HR2). De-energizing relay HR2 closes a set of normally closed HR2 contacts to activate the heating control circuit enabling the system to provide heating during the cooling with reheat mode.

Evaporator Fan Relay #1 (EFR1)

Evaporator Fan Relay #1 (EFR1) is located in the electrical control panel. When the Air Conditioning Switch (ACS) is placed in either the COOL or HEAT position, EFR1 relay is energized. When energized, a set of internal EFR1 contacts are closed to start Evaporator Fan Motors (EM1 and EM2).

Evaporator Speed Relays #1 and #2 (ESR1 and ESR2)

The Evaporator Speed Relays (ESR1 and ESR2) are located in the electrical control panel. These relays will only energize when the A/C Switch (ACS) is in the HEAT position. When energized, normally closed ESR1 and ESR2 contacts will close to start low speed evaporator fan motor operation.

Condenser Fan Relay #1 (CFR1)

The Condenser Fan Relay #1 (CFR1) is located in the electrical control panel. When the A/C Switch (ACS) is placed in the COOL position, A/C Relay (ACR) is energized closing a set of normally open ACR1 contacts. And, when the thermostat calls for cooling, power is applied to thermostat plug J1, pin no. 3, to energize CFR1 relay through the closed ACR1 contacts. When energized, a set of normally open CFR1 contacts close to start the Condenser Fan Motors (CM1, CM2 and CM3). The Low Ambient Thermostat (LATH) and Freeze Thermostat Switches (FTS), if installed, must also be closed to energize the Condenser Fan Relay.

Condenser Speed Relay (CSR)

The Condenser Speed Relay (CSR) is located in the electrical control panel. This relay is energized at the same moment the Condenser Fan Relay is energized provided the Condenser Fan Speed Switch (CSR) is closed. When energized, the CSR relay will open a set of normally closed CSR1 contacts to operate condenser fans on low speed. If the condenser coil pressure reaches the CFS switch cutout setting, the CFS switch will open to de-energize the Condenser Speed Relay (CSR). De-energizing the CSR relay will close a set of normally closed CSR1 contacts enabling the Condenser Fan Motors (CM1, CM2 and CM3) to operate on high speed.

Boost Pump Relay (BPR)

The Boost Pump Relay (BPR) is located in the electrical control panel. This relay is energized during heating. When the Boost Pump Relay (BPR) is energized, a set of normal open BPR contacts will close to activate the Boost Pump Motor (BPM).

Low Voltage Cutout (LVCO)

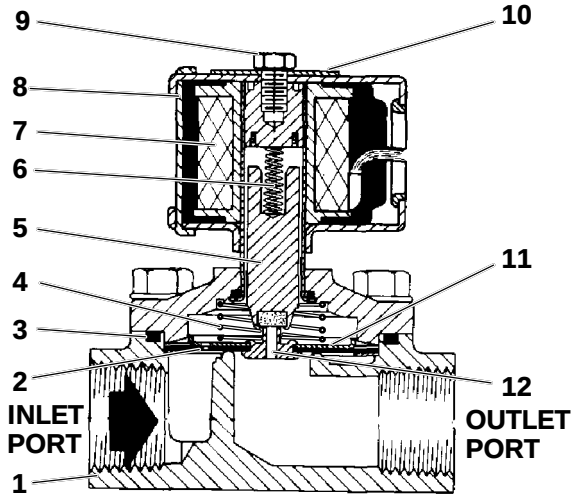
The Low Voltage Cutout (LTCO) is located in the electrical control panel. If this relay detects a low voltage condition, LVCO contacts will open to de-energize Clutch Relay (CR), which disengages the clutch.

1.6 REHEAT COOLANT VALVE

The Reheat Coolant Valve (RCV) is located in the evaporator section of the unit on the roof of the bus. (See Figure 1-1.) The valve is an electrically operated solenoid valve controlled by thermostat command. The RCV controls the coolant flow to the heater coil during heating. The valve is normally closed and opens when the coil is energized, and closes when the coil is de-energized.

When the thermostat calls for heating, the RCV coil is energized, the plunger is lifted and the pilot port is opened to relieve the pressure on top of the diaphragm. Now the valve inlet pressure will act on the bottom portion of the diaphragm, lifting the diaphragm to open the main port. Once the port is open, the diaphragm is held off the seat by the pressure difference across the port. When the coil is de-energized, the plunger drops due to the kick-off spring and the pilot port closes. The pressure above the diaphragm is no longer vented to the downstream side of the valve and the diaphragm drops, closing the main port.

The valve's Maximum Operating Pressure Differential (MOPD) is 35. The MOPD is the maximum pressure differential against which the solenoid will open. The valve has a 10 gallon per minute minimum capacity with a 3 psig pressure differential across the valve.



1. Valve Body
2. Equalizer Port
3. O-Ring
4. Closing Spring
5. Plunger
6. Kick-Off Spring
7. Coil
8. Coil Housing Assembly
9. Coil Retaining Screw
10. Nameplate
11. Diaphragm
12. Pilot Port

Figure 1-4. Reheat Coolant Valve

1.7 LIQUID LINE SOLENOID VALVE

The Liquid Line Solenoid Valve (LLS) is located in the evaporator section of the unit on the roof of the bus (See Figure 1-1.) The electrically operated solenoid valve is energized when the Clutch Relay (CR) is energized. The liquid line solenoid valve controls the flow of the refrigerant to the expansion valve during cooling (air conditioning) mode. The valve is normally closed and opens when the coil is energize, and closes when the coil is de-energized.

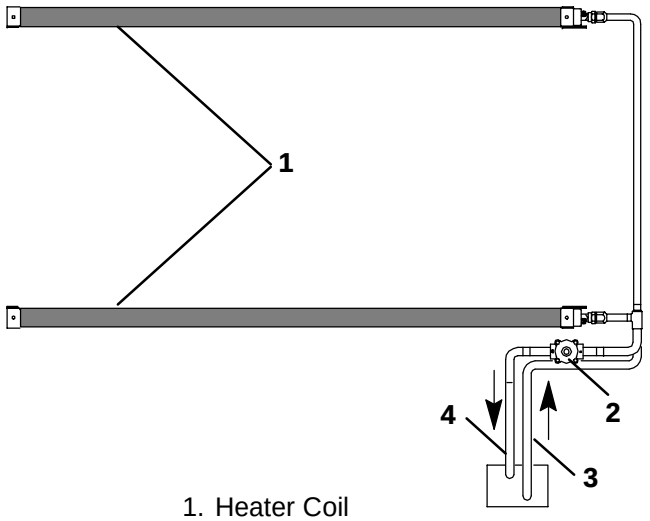
1.8 MOISTURE/LIQUID INDICATOR

The moisture indicator is located on the liquid line between the liquid line solenoid and the expansion valve. The element in the indicator is highly sensitive to moisture and will gradually change color in direct relation to an increase or decrease in the moisture content of the system. The dry-caution-wet system operating conditions are then easily determined by matching the element color with the four colors displayed on the reference label. Colors change as often as the system moisture content changes.

1.9 HEATER COOLANT FLOW CYCLE

Heating is controlled by the thermostat which controls the operation of the Reheat Coolant Valve (RCV). When the coolant valve solenoid is energized, the valve will open to allow engine coolant to flow through the heater coil. Refer to section 2.3.3 for control operation.

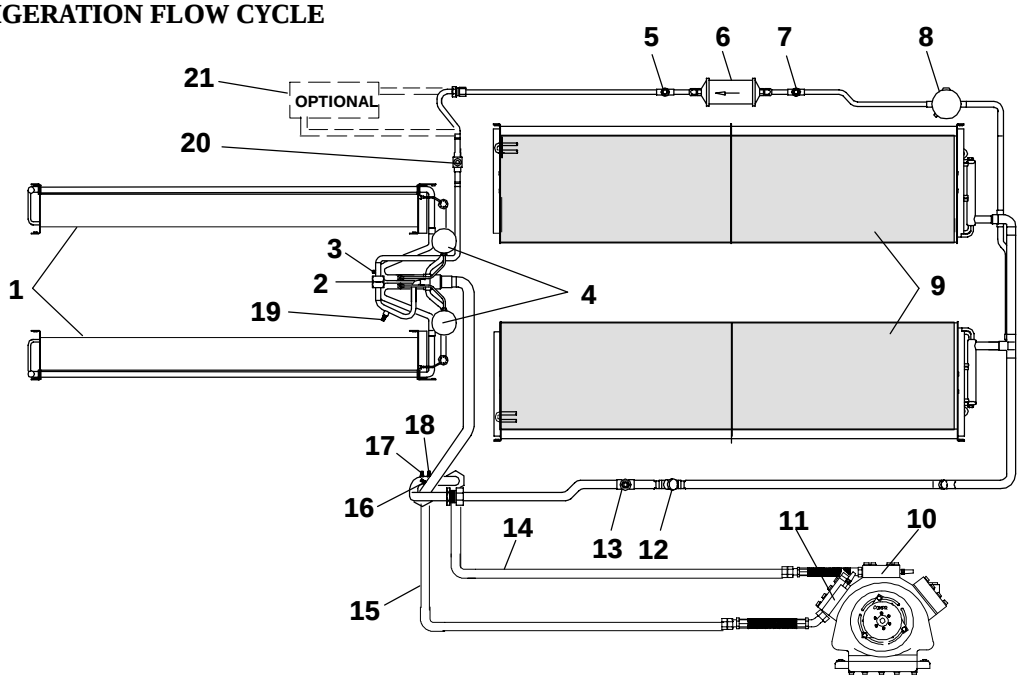
At the same time the coolant valve is energized, the boost pump (customer supplied) is activated to circulate the engine coolant through the inlet tube and header hose to the heater coil. The coolant exits the coil and flows through the valve inlet hose. With the coolant valve opened, coolant flows through the valve outlet and coolant outlet tube back to the engine.



1. Heater Coil
2. Reheat Coolant Valve
3. Coolant Inlet Tube
4. Coolant Outlet Tube

Figure 1-5. Heater Coolant Flow Diagram

1.10 REFRIGERATION FLOW CYCLE



1. Evaporator Coils
2. Inline Sight Glass
3. Low Pressure Service Port
4. Expansion Valves
5. Filter-Drier Outlet Valve
6. Filter-Drier
7. Filter-Drier Inlet Valve
8. Receiver
9. Condenser Coils
10. Discharge Service Valve
11. Suction Service Valve
12. Discharge Check Valve
13. Discharge Line Valve
14. Discharge Line
15. Suction Line
16. Unloader Pressure Port 2
17. Unloader Pressure Port 3
18. Condenser Fan Pressure Port
19. High Pressure Service Port
20. Liquid Line Solenoid Valve
21. Optional Suction Gas to Liquid Line Heat Exchanger

Figure 1-6. Refrigeration Cycle Diagram

The refrigeration system contains R-134a refrigerant. The refrigeration cycle is the same for air conditioning and heating (during reheat mode). The refrigerant cycle is off during the vent only mode, only the evaporator blowers operate to circulate air throughout the bus.

The refrigeration cycle begins when the compressor clutch is engaged. The compressor raises the pressure and the temperature of the refrigerant and forces it into the condenser tubes. The condenser fan circulates surrounding air (which is at a lower temperature than the refrigerant) over the outside of the condenser tubes. Heat is transferred from the refrigerant (inside the tubes) to the condenser air (flowing over the tubes). The condenser tubes have fins designed to improve the transfer of heat from the refrigerant gas to the air. This removal of heat causes the refrigerant to liquefy. The liquid refrigerant leaves the condenser and flows to the receiver.

The receiver serves as a liquid refrigerant reservoir so a constant supply of liquid is available to the evaporator as needed and as a storage space when pumping down the system. The receiver is equipped with a sight glass to check for the correct refrigerant level.

The refrigerant leaves the receiver and flows through the filter-drier inlet service valve to the filter-drier, which contains an absorbent for keeping the refrigerant clean and dry. The refrigerant flow continues through a filter-drier outlet service valve.

The liquid refrigerant then flows through a normally closed liquid line solenoid valve. When the compressor clutch is engaged, 24-volts is also applied to the liquid line solenoid valve coil opening the valve and allowing liquid to flow.

The liquid refrigerant then flows through an externally equalized thermostatic expansion valves, which reduces the pressure and temperature of the liquid and meters the flow of liquid refrigerant supplied to the evaporator coil to maximum use of the evaporator heat transfer surface.

The low pressure, low temperature liquid refrigerant that flows into the evaporator tubes is colder than the air circulating over the outside of the evaporator tubes by the evaporator blowers. Heat is transferred from the evaporator air circulating over the outside of tubes to the liquid refrigerant flowing inside the tubes. The evaporator tubes have aluminum fins to increase heat transfer from the air to the refrigerant. The resultant cooler air is then circulated throughout the interior of the bus.

The transfer of heat from the air to the low temperature liquid refrigerant in the evaporator causes the liquid to vaporize. This low temperature, low pressure vapor passes through the suction line back to the compressor where the cycle is repeated.

SECTION 2

OPERATION

2.1 STARTING AND STOPPING INSTRUCTIONS

a. Starting

1. Start the vehicle engine.

2. Switch the driver's A/C Switch (ACS) to the desired mode of operation (COOL or HEAT position).

NOTE

The Run Control Switches (RCS1 and RCS2), one located in the return air opening and one located on top of the evaporator section below the lid, must be in the ON position to start unit operation.

b. Stopping

1. Switch the driver's A/C Switch (ACS) to the OFF position.

NOTE

Be sure air conditioning unit is turned off before stopping the engine.

2.2 PRE-TRIP INSPECTION

After starting unit, allow system to stabilize (10 to 15 minutes) and proceed as follows:

1. Listen for abnormal noises.
2. Check compressor oil level.
3. Check refrigerant level.
4. Check moisture-liquid indicator.

2.3 UNIT OPERATION

The desired COOL or HEAT position for cooling or heating mode of operation is selected manually on the A/C Switch (ACS) located on the driver's switch panel. The selection of CYCLING (Clutch) or REHEAT cooling control is selected manually on the Reheat/Cycle Switch located on the unit's control panel on the roof of the vehicle. When a mode of operation is selected, the Electronic Thermostat (TH) senses the vehicle's interior temperature and automatically controls the system to maintain the desired temperature setpoint.

The cycling clutch and reheat control actions are functional only during operation of the cooling cycle (when the A/C Switch is set to the COOL position). When the A/C Switch is in the HEAT position, the A/C Relay (ACR) is de-energized, opening the circuit to the cooling control components.

The unit control circuit operates on 24-volts supplied by the bus battery or alternator.

2.3.1 Cooling (Air Conditioning) Cycle Operation – Cycling Clutch Control (See Figure 2-1.)

To operate in cycling clutch mode of operation, the Reheat/Cycling Switch (RHCS) is placed in the CYCLE position. In this position, the thermostat cycles the compressor on and off to control vehicle interior temperature.

When the driver's A/C Switch (ACS) is placed in the COOL position and the thermostat is calling for cooling, the air conditioning (cooling) circuit is activated. With the switch in this position, 24-volts is supplied to the A/C Relay (ACR), which closes a set of normally open (ACR1) contacts to activate the cooling control circuit components. Voltage is also applied to the Run Control Switches (RCS1 and RCS2). With these switches in the ON position, voltage is also applied to energize Fault Relay (FR), Evaporator Fan Relay (EFR1) and Low Voltage Cutout relay (LVCO). Energizing the Evaporator Fan Relay closes normally open EFR1 contacts to start high speed evaporator fan operation through the normally closed ESR1 and ESR2 contacts. During the cooling mode, the evaporator fans always operate on high speed. During the heating mode, the evaporator fans always operate on low speed.

Energizing the Fault Relay closes a set of normally open FR contacts to apply power to activate the cooling control circuit and, provided there is no high or low pressure refrigerant condition, opens the circuit to the stop light. The Low Voltage Cutout Relay senses circuit control voltage and de-energizes to open normally open LVCO, contacts, which de-energizes the Clutch Relay (CR) when a low voltage condition occurs. Voltage is also applied to Electronic Thermostat (TH), pin no. 4, and one REHEAT terminal of the Reheat/Control Switch (RCHS). Applying power to the thermostat allows it to automatically select heating or cooling and unloaded, semi-loaded or fully loaded compressor operation to maintain bus interior temperature.

When the vehicle's interior temperature rises to +1˚F above the thermostat setpoint, the thermostat switches from high speed vent operation to high speed unloaded (2-cylinder) cool operation. During the high speed vent mode (See Figures 2-1 and 2-4.), the thermostat de-activates the cooling circuit by removing power from thermostat plug J1, pin no. 3. The evaporator fans continue to operate on high speed to circulate air within the bus.

In the high speed unloaded cool mode (See Figures 2-1 and 2-5.), the thermostat switches to the cool position, applying power to thermostat plug J1, pin no. 3; this energizes the Clutch Relay (CR), Condenser Speed Relay (CSR) and Condenser Fan Relay (CFR1) through the closed ACR1 and LVCO contacts. Energizing the Clutch Relay (CR) closes a set of normally open CR contacts , which activates the refrigerant control circuit, through the closed FR and ACSR contacts, to start the refrigerant flow cycle. Energizing the Condenser Fan Relay (CFR1) closes a set of normally open CFR1 contacts, which applies power to start Condenser Fan Motors (CM1, CM2 and CM3). Energizing Condenser

Speed Relay (CSR) opens a set of normally closed contacts to switch to low speed condenser fan operation. At this point, the thermostat also applies power to plug J1, pin no.6 and pin no. 5 to energize Unloader Valves #1 and #2 (UV1 and UV2), which unloads two banks of compressor cylinders . The compressor now operates in unloaded (2-cylinder) cool mode.

When the vehicle's interior temperature rises to +3˚F above the thermostat setpoint, the thermostat switches from high speed unloaded (2-cylinder) cool operation to high speed semi-loaded (4-cylinder) cool operation. In the semi-loaded cool mode (See Figures 2-1 and 2-6.), the thermostat removes power from plug J1, pin no. 6., which de-energizes Unloader Valve #1 (UV1) to load two additional compressor cylinders. The compressor now operates in semi-loaded (4-cylinder) cool mode. However, Unloader Pressure Switch (UPS2) can override the thermostat demand for semi-loaded operation by closing a set of contacts to energize Unloader Valve UV1, unloading a bank of compressor cylinders when refrigerant suction pressure drops below its setpoint.

When the vehicle interior temperature rises to +5˚F above the thermostat setpoint, the thermostat switches from high speed semi-loaded cool operation to high speed fully loaded cool operation. In the high speed fully loaded cool mode (See Figures 2-1 and 2-7), the thermostat removes power from plug J1, pin no. 5, which de-energizes Unloader Valve #2 (UV2) to load the two remaining compressor cylinders. The compressor now operates in fully loaded (6-cylinder) cool mode.

On a falling temperature, the controller sequence changes in reverse to the above. See Figure 2-1 for controller sequence on falling temperature.

2.3.2 Cooling (Air Conditioning) Cycle Operation – Reheat Control (See Figure 2-2.)

When the vehicle interior temperature falls to -1˚F below the thermostat setpoint and the Reheat/Cycle Switch (RHCS) is set to the REHEAT position, the thermostat switches from cooling only operation to cooling with reheat. (See Figures 2-2 and 2-8.) Under normal conditions (i.e., with ACR, LATH, FTS, CFS and LVCO contacts closed), and with the ACS switch in the COOL position and the RHCS switch in the REHEAT position, the cooling circuit is always energized (i.e., clutch relay and condenser fans are energized). In this mode, the thermostat cycles the reheat control circuit to maintain vehicle interior temperature. When reheat is required on a falling temperature, at -1˚F below the setpoint, the thermostat removes power from plug J1, pin no. 3, which de-energizes Heat Relay #2 (HR2) to close normally closed HR2 contacts and energize Reheat Coolant Valve (RCV) solenoid and Boost Pump Relay (BPR); this activates the reheat control circuit. Energizing the Boost Pump Relay closes normally open BPR contacts to start the Boost Pump Motor (BPM). Energizing the reheat coolant valve solenoid coil opens the valve allowing flow of engine coolant to the heater coil for heating.

On a rising temperature to +1˚F above the thermostat setpoint, the thermostat switches from high speed cool with reheat to high speed cool only mode.

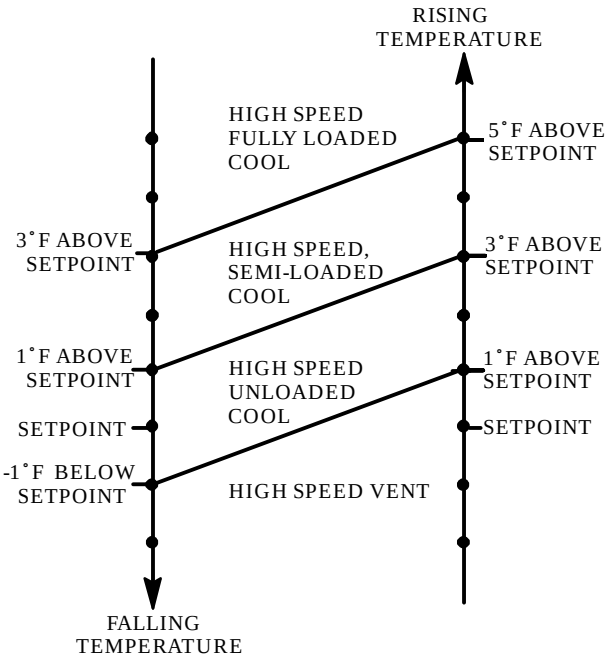


Figure 2-1. Temperature Controller Sequence During Cooling Mode

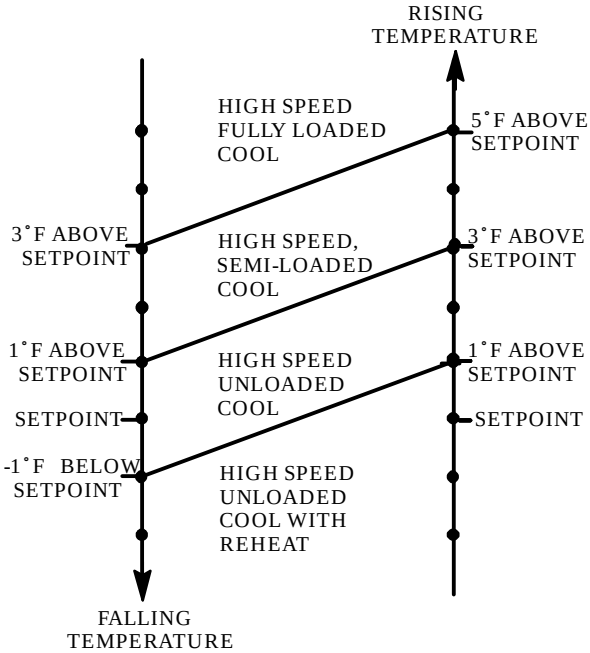


Figure 2-2. Temperature Controller Sequence During Cooling with Reheat Mode

2.3.3 Heat Operation (See Figure 2-3.)

The driver's A/C Switch (ACS) is placed in the HEAT position to activate the heating cycle. With this switch in the HEAT position, 24-vdc is applied to energize Heat Relay (HR) and Evaporator Speed Relays (ESR1 and ESR2). Energizing the Heat Relay (HR) closes a set of normally open HR contacts, which allows the thermostat to energize Boost Pump Relay (BPR) and Reheat Coolant Valve (RCV) upon a demand for heating. Energizing Evaporator Speed Relays (ESR1 and ESR2) opens normally open ESR1 and ESR2 contacts to start low speed evaporator fan operation provided Evaporator Fan Relay (EFR1) is energized. Energizing Boost Pump Relay (BPR) closes normally open BPR contacts to start Boost Pump Motor (BPM). Energizing Reheat Coolant Valve (RCV) opens the valve and starts the flow of engine coolant through the heating coils for heating.

When the ACS switch is in the Heat position, power is also supplied to Run Control Switch (RCS1). With Run Control Switches (RCS1 and RCS2) in the ON position, power is applied through the Run Control Switches to energize Fault Relay (FR), Evaporator Fan Relay (EFR1) and Low Voltage Cutout Relay (LVCO). Energizing the Fault Relay closes a set of normally open FR contacts in the cooling control circuit and, provided there is no high or low pressure refrigerant condition, opens the circuit to the stop light. The Low Voltage Cutout Relay senses circuit control voltage and de-energizes to open normally open LVCO contacts to de-energize the Clutch Relay (CR) during cooling, when a low voltage condition occurs.

When the vehicle interior temperature falls to -2˚F below the thermostat setpoint, the thermostat switches from low speed vent to low speed heat mode. (See Figures 2-3 and 2-9.) In this mode, the thermostat applies power to plug J1, pin no. 1, to energize Boost Pump Relay (BPR) and Reheat Coolant Valve (RCV) through the closed HR contacts. Energizing Boost Pump Relay (BPR) closes normally open BPR contacts to start Boost Pump Motor (BPM). Energizing Reheat Coolant Valve opens the valve and starts the flow of engine coolant through the heating coils. During the heating cycle, this valve is opened and closed and the pump is started and stopped on thermostat command to control vehicle interior temperature.

When the vehicle interior temperature rises to the setpoint, the thermostat switches from low speed heat to low speed vent mode. In this mode, the thermostat removes power from plug J1, pin no. 1, which de-energizes the Reheat Coolant Valve (RCV) and Boost Pump Relay (BPR) to stop the flow of coolant to the heating coils. The evaporator fans will continue to operate on low speed to circulate air throughout the vehicle.

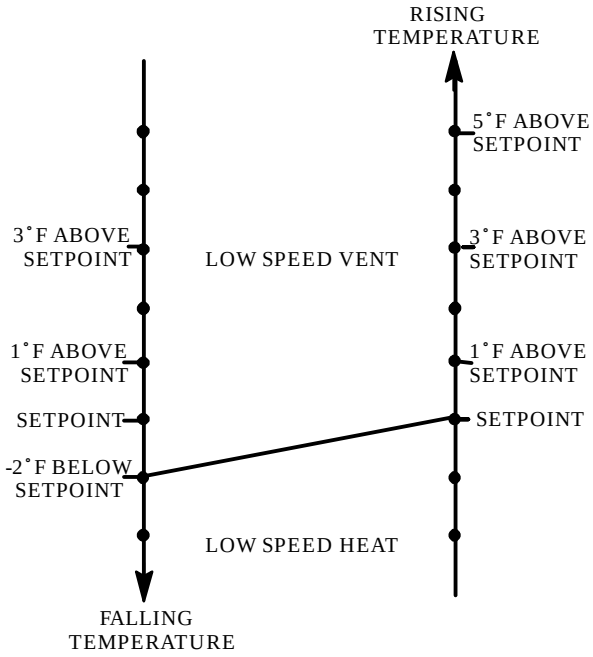


Figure 2-3. Temperature Controller Sequence During Heating Mode

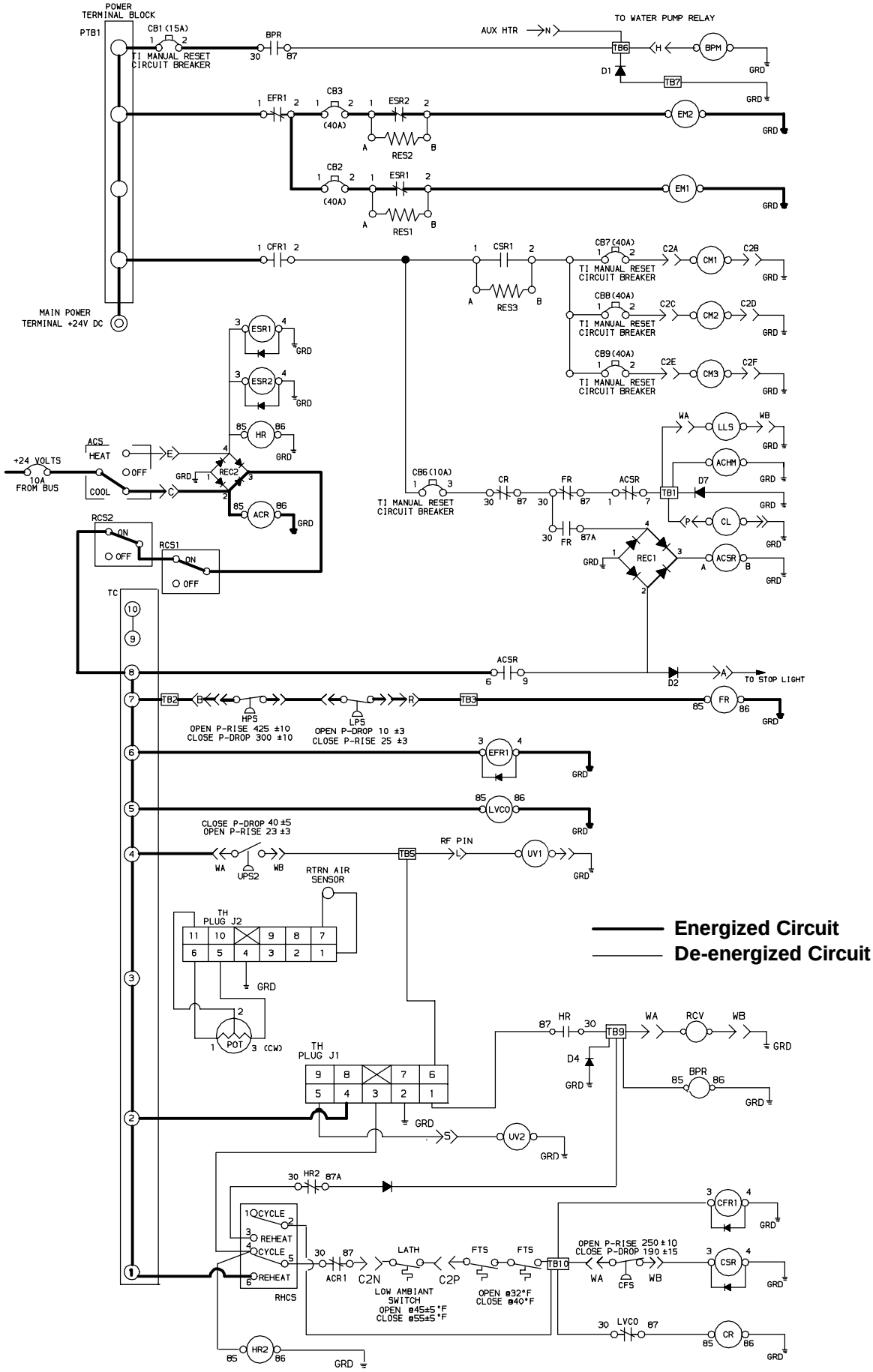


Figure 2-4. Cooling Cycle–High Speed Vent Mode Operation

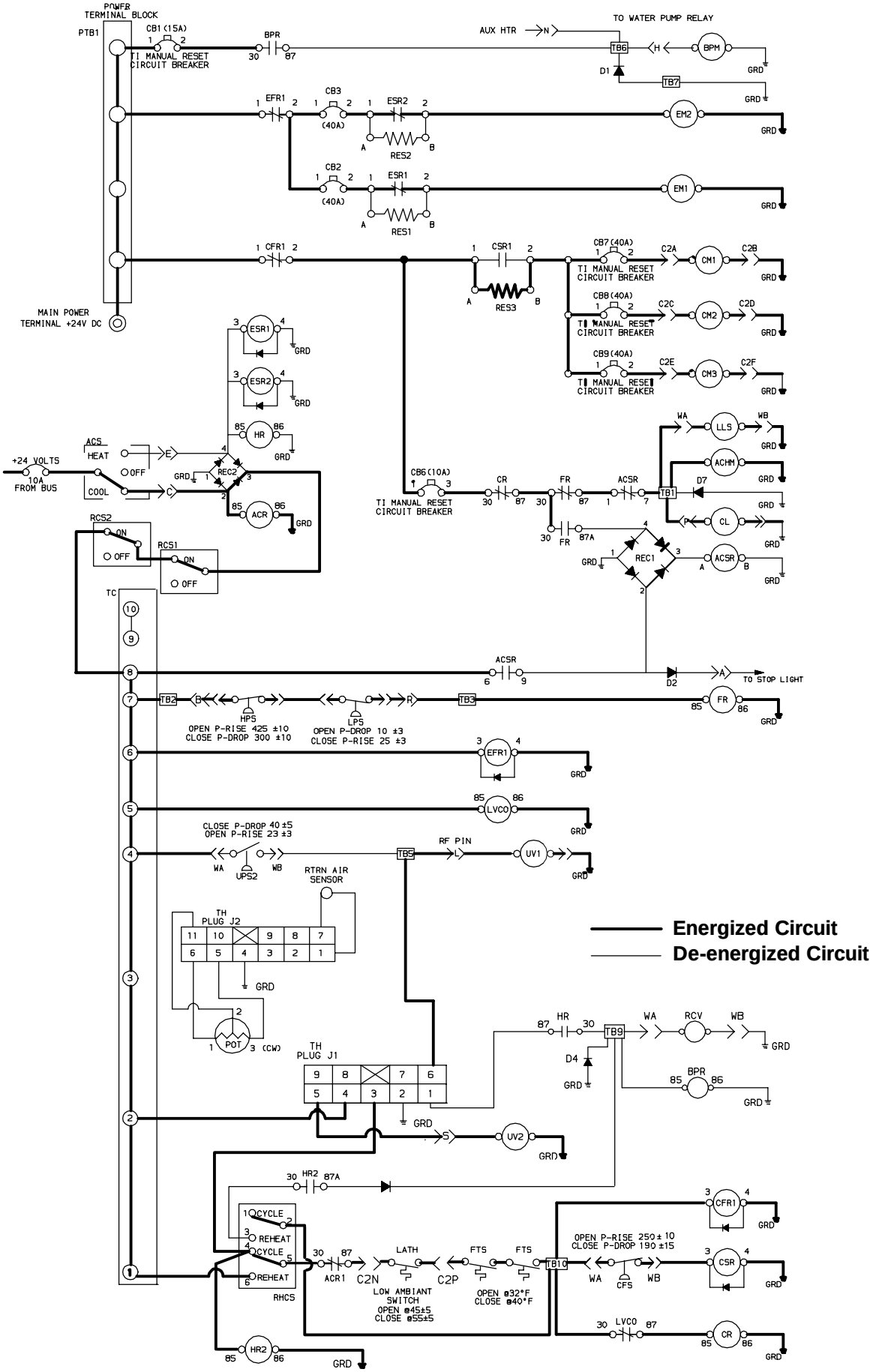


Figure 2-5. High Speed Unloaded (2-cylinder operation) Cool Mode Operation

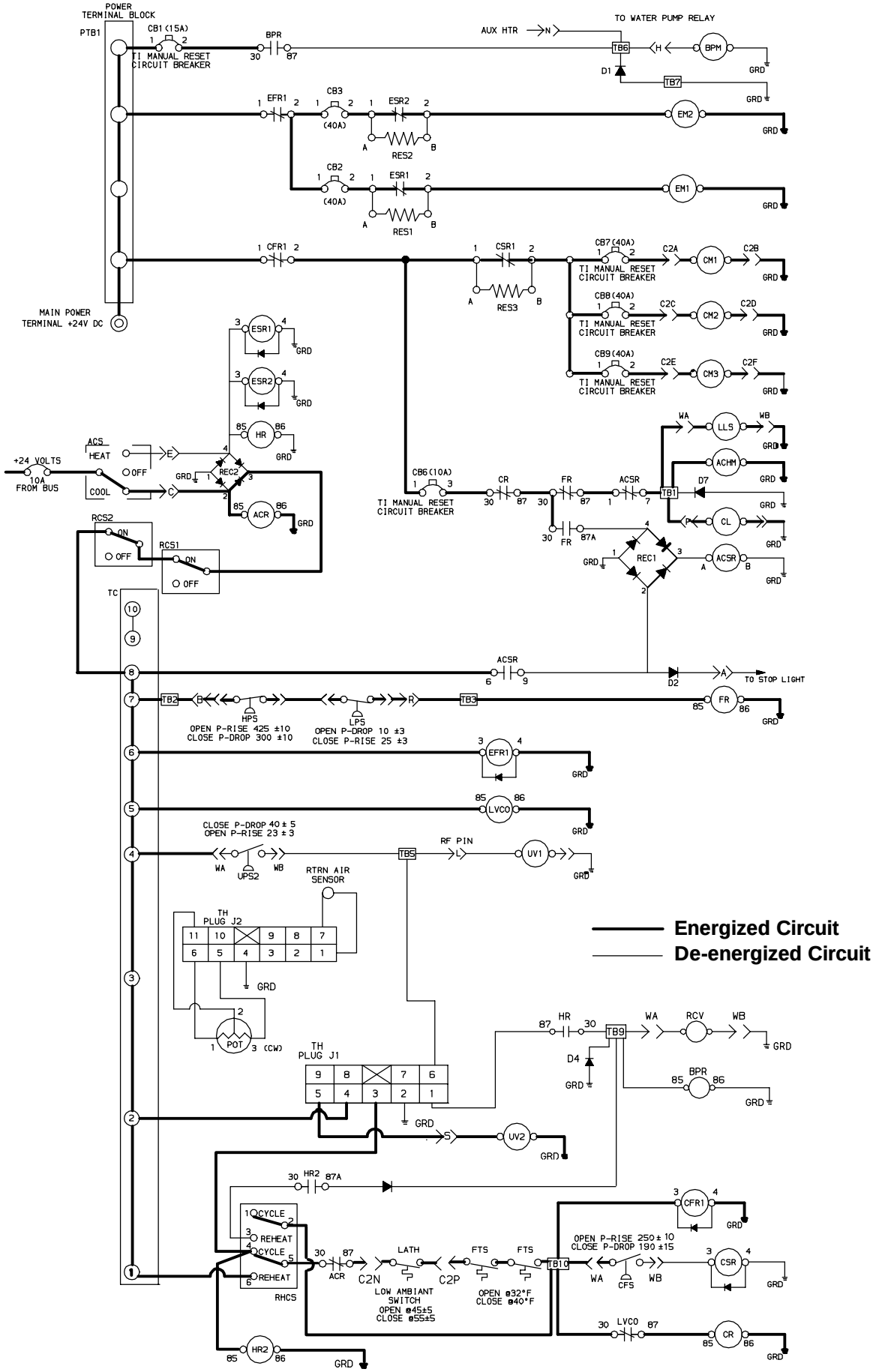


Figure 2-6. High Speed Semi-Loaded (4-cylinder operation) Cool Mode Operation

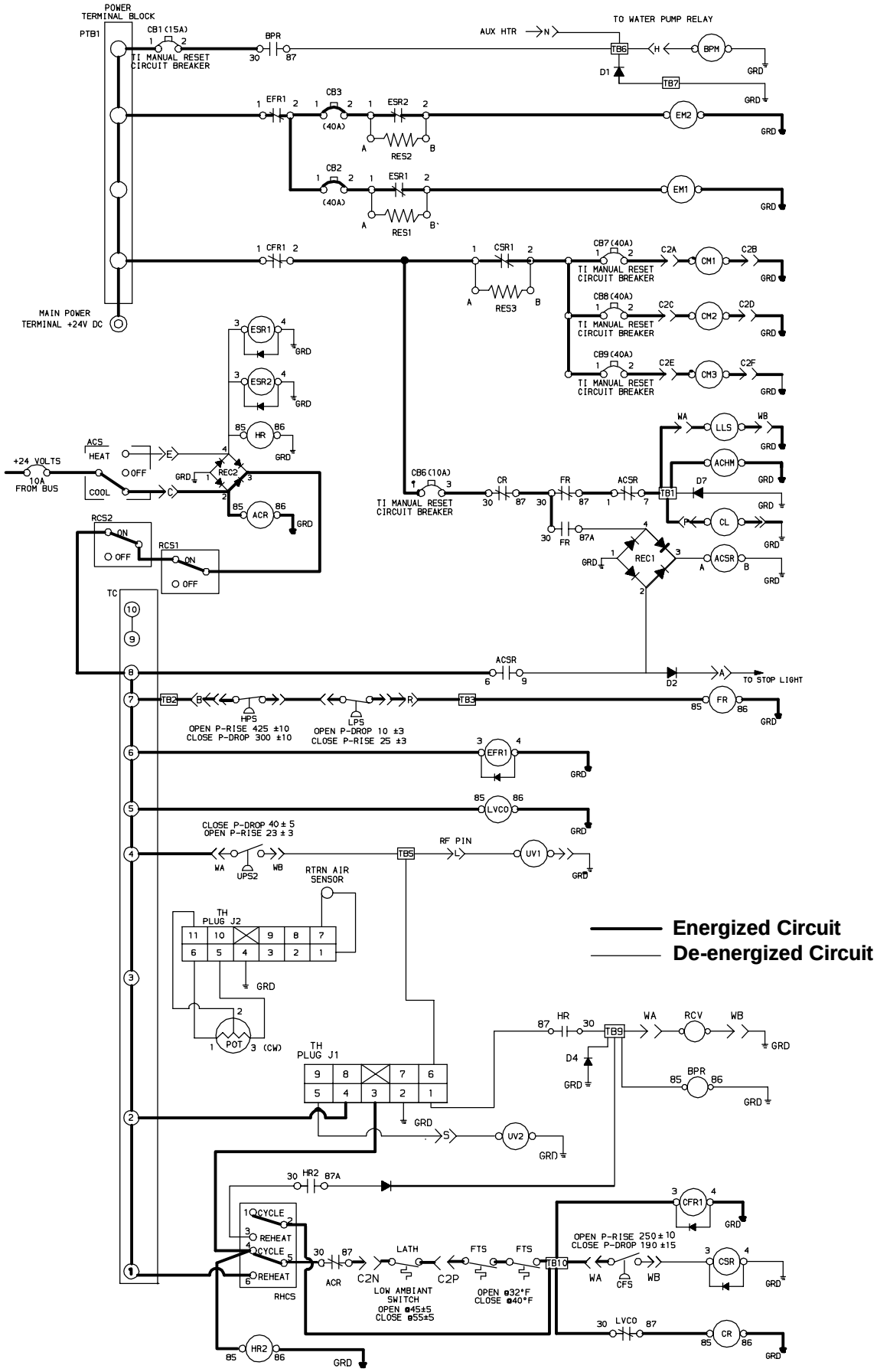


Figure 2-7. High Speed Fully Loaded (6-cylinder operation) Cool Mode Operation

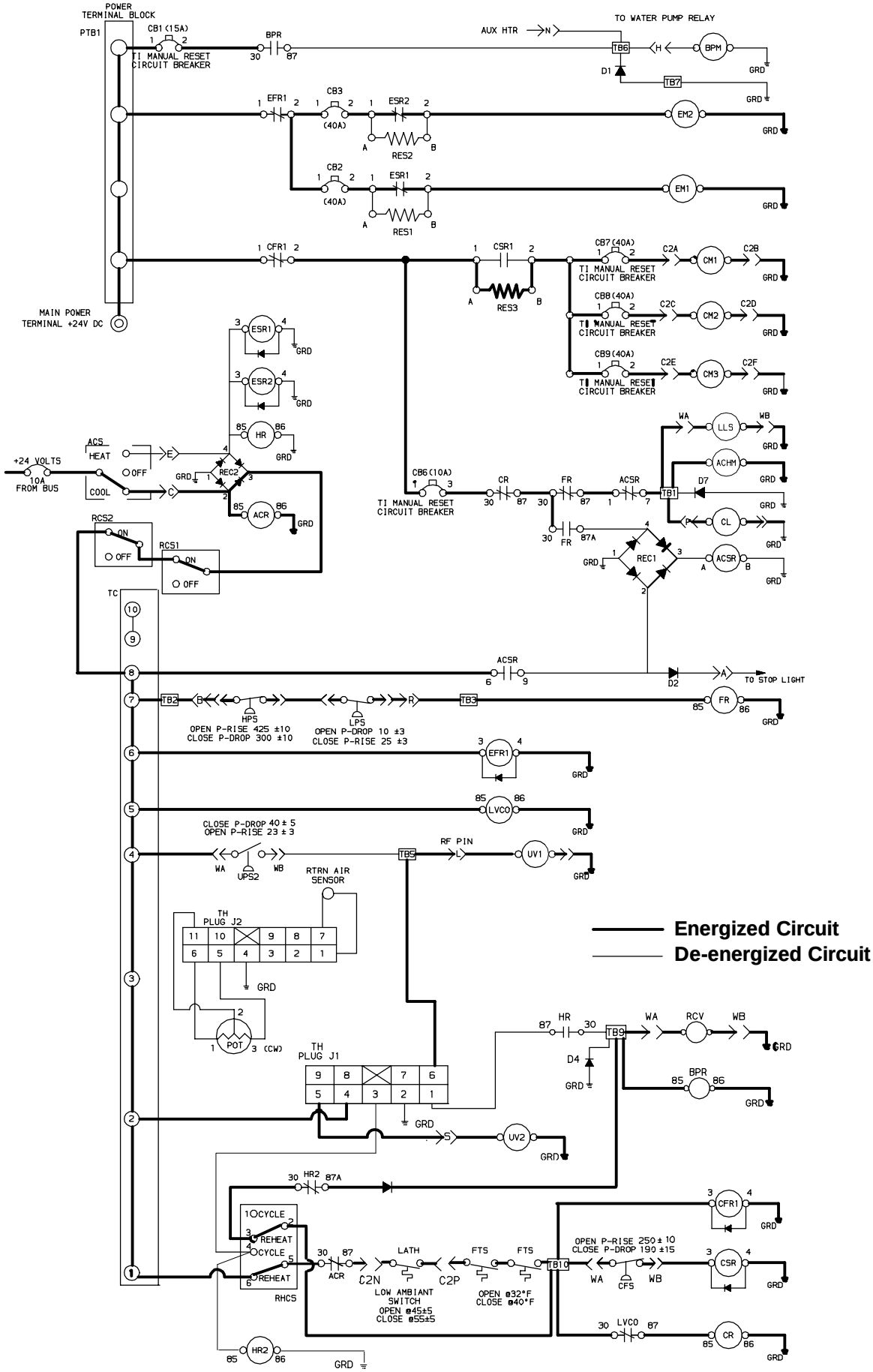


Figure 2-8. High Speed Unloaded (2-cylinder operation) Cool with Reheat Mode Operation

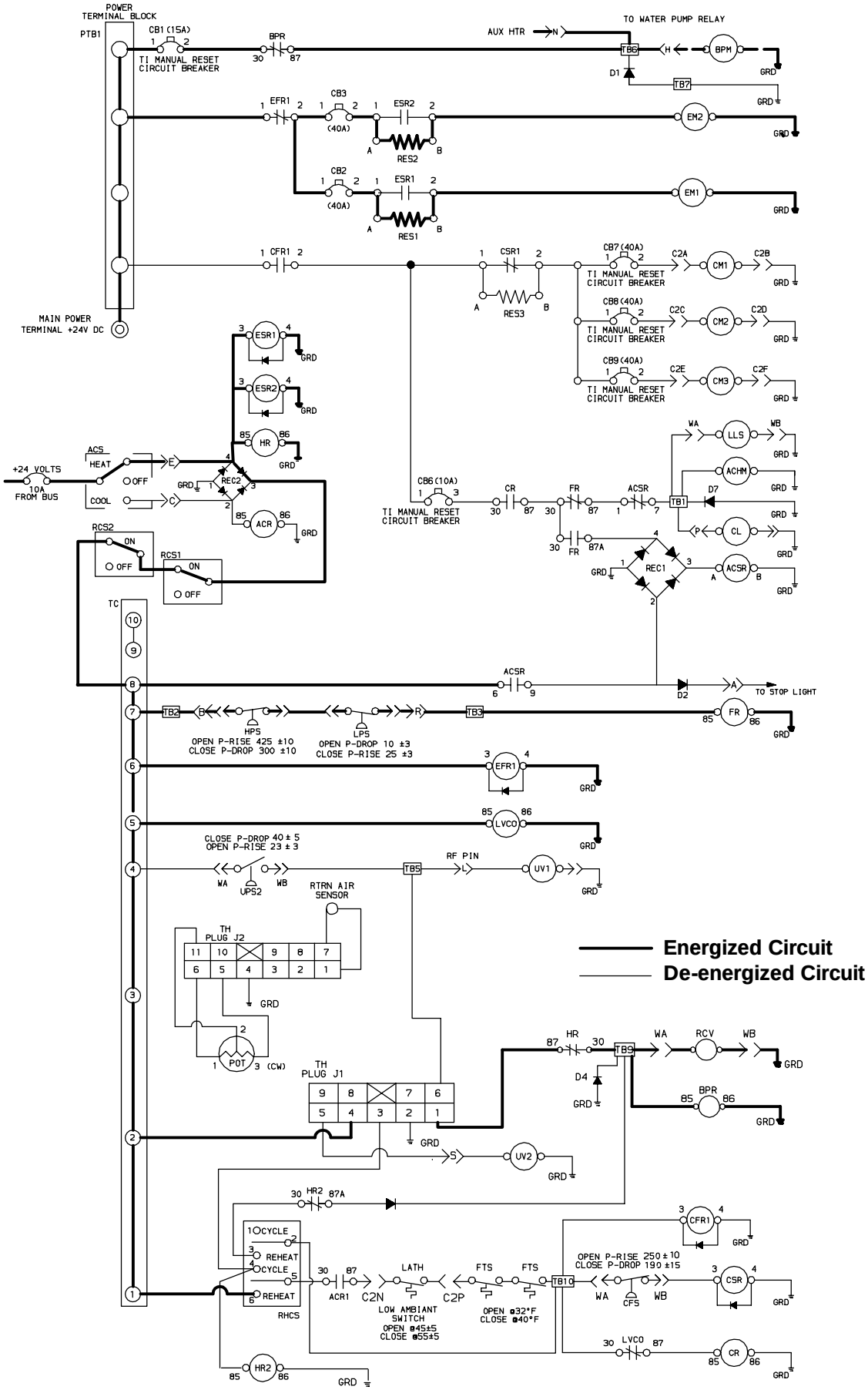


Figure 2-9. Heating Cycle – Low Speed Heat Mode Operation

SECTION 3

TROUBLESHOOTING

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1 UNIT WILL NOT COOL		
Compressor will not run	V-Belt broke or defective	Check
	Compressor malfunction	See Note
	Clutch malfunction	Check/Replace
	Safety device open	1.4
Electrical malfunction	A/C switch defective	Check
	A/C relay defective	Check/2.3
	Low Ambient Thermostat open	1.5.c
	Circuit breaker CB6 open	Check/Reset
	Temperature Controller malfunction	3.5
	Run Control Switch in OFF position	Check
	Liquid Line Solenoid malfunction	4.16
3.2 UNIT RUNS BUT HAS INSUFFICIENT COOLING		
Compressor	Compressor valves defective	See Note
	V-belt loose	Check
Refrigeration system	Abnormal pressures	3.4
	No or restricted evaporator air flow	2.3
	Expansion valve malfunction	3.7
	Restricted refrigerant flow	3.7
	Low refrigerant charge	4.9
	Service valves partially closed	Open
	Safety device open	1.4
3.3 ABNORMAL PRESSURE		
High discharge pressure	Refrigerant overcharge	4.9
	Noncondensibles in system	Check Pressure
	Condenser fan motor rotation incorrect	Check/Reverse Motor Electrical Leads
	Condenser coil dirty	Clean
Low discharge pressure	Compressor valves(s) worn or broken	See Note
	Low refrigerant charge	4.9
High suction pressure	Compressor valves worn or broken	See Note

NOTE: Refer to 05G Compressor manual, Form T-199.

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3 ABNORMAL PRESSURE CONT'D		
Low suction pressure	Suction service valve partially closed	Open
	Filter-drier inlet and outlet valves partially closed	Check/Open
	Filter-drier partially plugged	4.10
	Low refrigerant charge	4.9
	Expansion valve malfunction	3.7
	Restricted air flow	3.6
	Liquid line solenoid malfunction	4.16
Low evaporator air flow	Blower running in reverse	Check/3-6 and/or Reverse Motor Electrical Leads
	Dirty air filter	4.19
	Icing of coil	Defrost and Clean
Suction and discharge pressures tend to equalize when unit is operating	Compressor valves defective	See Note
3.4 ABNORMAL NOISE AND VIBRATIONS		
3.4.1 ABNORMAL NOISE		
Compressor	Loose mounting bolts	Check/Tighten
	Worn bearings	See Note
	Worn or broken valves	See Note
	Liquid slugging	3.3
	Insufficient oil	Check/4.20.2
	Clutch loose or rubbing	Check/Tighten
Condenser or Evaporator fan	Loose or defective	4.17 & 4.18
	Bearings	Replace
	Blade Interference	4.17 & 4.18
	Blade broken or missing	4.17 & 4.18
3.4.2 ABNORMAL VIBRATION		
Compressor	Loose mounting bolts	Check/Tighten
Evaporator or Condenser fan	Bent shaft on motor	4.17 & 4.18
	Blade broken or missing	4.17 & 4.18
3.5 TEMPERATURE CONTROLLER MALFUNCTION		
Will not control	Controller defective	1.5.a/Replace
	Sensor defective	Replace
	Defective wiring	Check/Repair

NOTE: Refer to 05G Compressor manual, Form T-199.

3.6 NO EVAPORATOR AIR FLOW OR RESTRICTED AIR FLOW

No evaporator air flow	Motor burnout	4.18
	Fan damage	4.18
	Return air filter dirty	Check/4.19
	Fan Relay EFR1 defective	Check/1.5/Replace
	Safety device open	1.4
	Wiring polarity incorrect	Check/5.1

3.7 EXPANSION VALVE MALFUNCTION

Low suction pressure with high superheat	Low refrigerant charge	4.9
	Wax, oil or dirt plugging valve orifice	Check/4.12
	Ice formation at valve seat	4.7
	Superheat setting too high	4.12
	Power assembly failure	4.12
	Loss of bulb charge	4.12
	Broken capillary	4.12
	Loose bulb	Check/Tighten
Low superheat and liquid slugging in compressor	Superheat setting too low	4.12
	Ice holding valve open	4.7/4.12
	Foreign material in valve	4.7/4.12
	Pin and seat of expansion valve eroded or held open by foreign material	4.12
	Broken capillary	4.12
Fluctuating suction pressure	Improper bulb location or loose bulb installation	4.12
	Low superheat setting	4.12

3.8 NO HEATING OR INSUFFICIENT HEATING

Insufficient heating	Dirty or plugged heater coil	Check/Clean
	Coolant valve malfunction or plugged	4.15
	Low coolant level	Check
No heating	Coolant valve malfunction or plugged	4.15
	Controller malfunction	15.a./3.5
	Boost pump relay or pump malfunction	1.5.e/2.3.3
	Safety device open	1.4

SECTION 4

SERVICE

WARNING

BEWARE OF ROTATING FAN BLADES AND UNANNOUNCED STARTING OF FANS.

4.1 MAINTENANCE SCHEDULE

UNIT		OPERATION	REFERENCE SECTION
ON	OFF		
a. Daily Maintenance			
X		Pre-trip inspection – after starting	2.2
	X	Check tension and condition of Compressor V-belt(s)	None
b. Weekly Inspection and Maintenance			
	X	Perform daily inspection	4.1.a
	X	Check condenser, evaporator coils and air filters	None
	X	Check refrigerant hoses and compressor shaft seal for leaks	4.6
X		Feel filter-drier for excessive temperature drop across drier.	4.10
c. Monthly Inspection and Maintenance			
	X	Perform weekly inspection and maintenance	4.1.b
	X	Clean evaporator drain pan and hose(s)	None
	X	Check wire harness for chafing and loose terminals	Repair/Tighten
	X	Check fan motor bearings	None
	X	Check compressor mounting bolts for tightness	Check/Tighten

4.2 SUCTION AND DISCHARGE SERVICE VALVES

The suction and discharge service valves used on the compressor are equipped with mating flanges for connection to flanges on the compressor. These valves are provided with a double seat and a gauge connection, which allows servicing of the compressor and refrigerant lines.

Turning the valve stem counterclockwise (all the way out) will *backseat* the valve to open the suction or discharge line to the compressor and close off the gauge connection. In normal operation, the valve is backseated to allow full flow through the valve. The valve should always be backseated when connecting the service manifold gauge lines to the gauge ports.

Turning the valve stem clockwise (all the way forward) will *frontseat* the valve to close off the suction or discharge line to isolate the compressor and open the gauge connection.

To measure suction or discharge pressure, midseat the valve by opening the valve clockwise 1/4 to 1/2 turn. With the valve stem midway between frontseated and backseated positions, the suction or discharge line is open to both the compressor and the gauge connection.

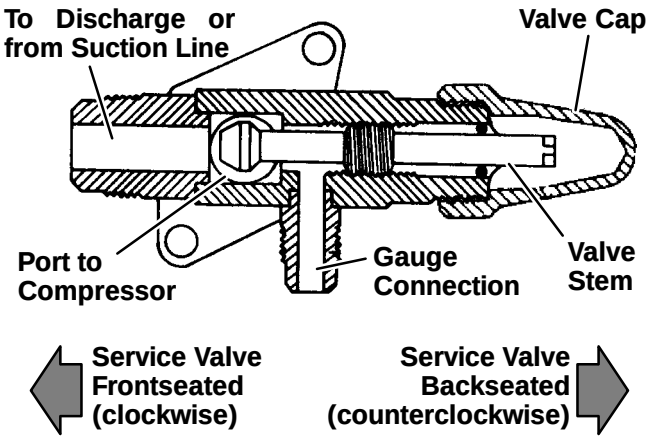


Figure 4-1. Suction or Discharge Service Valve

4.3 MANIFOLD GAUGE SET

The manifold gauge set can be used to monitor system operation pressure, add or remove refrigerant, evacuate, and equalize the system.

The manifold gauge in Figure 4-2 shows hand valves, gauges and refrigerant openings. When the manifold hand valves are backseated (open), the high and low side

hoses are common with the center hose as well as each other. When the low and high side valves are frontseated (closed), the high and low side hoses are isolated from each other and the center hose. It is in the front seated (closed) position that system pressures can be monitored. When both valves are open (backseated), pressure will cause vapor to flow from the high side to the low side across the compressor. When only the low side valve is opened, it is possible to add refrigerant in vapor form to the system.

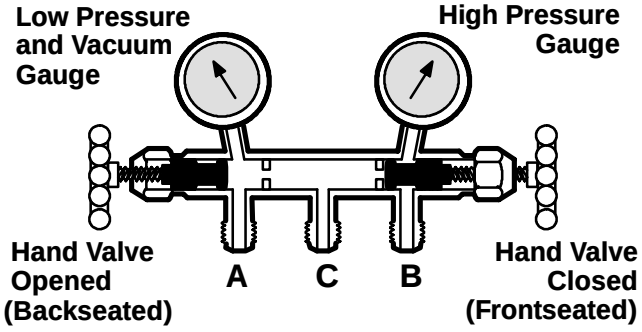

Low Pressure and Vacuum Gauge
High Pressure Gauge
Hand Valve Opened (Backseated)
A
C
B
Hand Valve Closed (Frontseated)
A. Hose Connection to Low Side of System
B. Hose Connection to High Side of System
C. Connection to/or for: Refrigerant Cylinder Oil Container

Figure 4-2. Gauge Manifold Set

a. Installing the Gauge Manifold Set

To avoid the unsafe conditions near the running compressor, the recommended gauge manifold set connection is to the service ports located in end of return air opening. These service ports are located at the end of the unit control panel.

The control panel connections are equipped with schrader fitting which open when the connection is made.

1. Frontseat the gauge manifold hand valves to close off the center port.

2. Connect the high side hose *tightly* to the discharge drop tube service port.

3. Connect the low side hose *loosely* to the suction drop tube service port.

4. Loosen gauge manifold charging (center) hose at dummy fitting.

5. Open (counterclockwise) manifold discharge hand valve to purge discharge line through the center hose dummy fitting. Tighten the center hose dummy fitting.

6. Open (counterclockwise) manifold suction hand valve to purge suction hose. Tighten the suction hose fitting at the suction quick connect (schrader) fitting.

4.4 SYSTEM PUMPDOWN

To service or replace the filter-drier, expansion valve, evaporator coil, or suction line; pump the system refrigerant into condenser coil and receiver tank as follows:

a. Attach the gauge manifold as outlined in section 4.3.

b. Disconnect low pressure switch quick connect. Install a jumper wire across switch connection to prevent the switch from disengaging the clutch.

c. Start the unit in A/C by placing the driver's A/C switch in the cool position. The thermostat should be set below ambient temperature to ensure A/C operation.

d. Run unit for 5 – 10 minutes to allow system to stabilize.

e. Frontseat (close) the liquid line valve at the inlet of the filter-drier.

f. Observe the suction gauge. The pressure will drop off noticeably. Stop the unit when a 0 to 10 in. vacuum is reached.

g. Stop the unit. Observe the suction gauge. If the reading increases, restart the unit until the specified vacuum is achieved.

h. Repeat the above step until the specified vacuum is maintained after stopping.

i. Before opening the system a slight positive pressure (1-2 psig) is necessary to prevent air from being drawn into the system.

4.5 REMOVING REFRIGERANT CHARGE

A refrigerant recovery system is the recommended method for removing refrigerant charge. For the recovery system procedure, refer to instructions provided by the manufacture.

A refrigerant recovery system should always be used whenever removing contaminated refrigerant from the system.

If a recovery system is not available, proceed as follows:

Equipment Required

1. Appropriate evacuated returnable refrigerant cylinder, preferably a 60 – 120 lb net capacity may be used. Refrigerant removal will be faster and more complete with the larger cylinder.

WARNING

Do not use a disposable refrigerant container to store the refrigerant, an explosion may occur.

2. Gauge manifold set.

3. Vacuum pump, preferably 5 cfm (8 cu/H) or larger. CTD P/N 07-00176-01.

4. Weight scale (0 to 100 lb = 0 to 46 kg range, minimum).

5. A standard 1/4 in. charging hose.

To remove the refrigerant charge:

a. Install a manifold gauge set as outlined in section 4.3.

b. Connect evacuated refrigerant cylinder to the liquid line valve at the inlet valve of the filter-drier. The service line to the liquid valve of the cylinder should be attached loosely. Crack open the liquid line valve momentarily to purge service line at cylinder. Tighten connection at cylinder.

c. Place evacuated refrigerant cylinder on scale and note weight of empty cylinder. Leave cylinder on scale.

d. Frontseat liquid line valve at the inlet of the filter-drier.

e. Run the unit in high speed cool with the condenser coil completely blocked off. Head pressure will quickly rise. Stop the unit when the system pressure reaches 250 psig for R-22 systems or 150 psig for R-134a systems using the run control switch.

f. Fully open the refrigerant cylinder liquid valve. Liquid refrigerant will flow from the liquid line valve to the cylinder. Head (discharge) pressure will drop.

g. Monitor weight of the refrigerant cylinder to determine how much refrigerant is being removed. Shut off cylinder valve when the scale weight has stabilized, indicating the refrigerant flow into the cylinder has stopped. Run the unit for a few more minutes to condense more liquid and raise head pressure.

NOTE

Refrigerant will flow from the system to the cylinder until the pressures equalize. It is possible to remove more refrigerant by cooling the refrigerant cylinder in a container of ice.

h. Backseat the liquid line valve and remove cylinder hose.

i. Service or replace the necessary component in the system.

NOTE

When opening up the refrigerant system, certain parts may frost. Allow the part to warm to ambient temperature before dismantling. This avoids internal condensation which puts moisture in the system.

4.6 REFRIGERANT LEAK CHECK

A refrigerant leak check should always be performed after the system has been opened to replace or repair a component.

To check for leaks in the refrigeration system, perform the following procedure.

a. If system is without refrigerant, charge system with refrigerant to build up pressure between 30 to 50 psig (2.1 to 3.5 kg/cm@).

NOTES

1. It is recommended that the appropriate refrigerant used, be used to pressurize the system.

2. Under no circumstance should the system be pressurized above 100 psig when leak testing.

b. Check for leaks. The recommended procedure for finding leaks in a system is with a halide torch or electronic leak detector.

c. Remove the refrigerant used to pressurize the system prior to leak repair using a recovery system.

d. Repeat the entire procedure if necessary.

e. Evacuate and dehydrate the system as outlined in section 4.7.

f. Charge the unit as outlined in section 4.8.1.

4.7 EVACUATION AND DEHYDRATION

Proper evacuation and dehydration procedures are imperative when service repairs or component replacement are performed on the system to ensure proper unit performance and long compressor life.

The results of improper evacuation are harsh. Noncondensibles gases in the system result in high head pressure; moisture may cause ice blockage at the expansion valve; moisture and refrigerant may react to form an acid. This acid may cause copper plating of the bearing surfaces and eventual compressor failure.

a. Equipment Needed

1. **Vacuum Pump –** A good vacuum pump (3 to 5 cfm volume displacement, at atmospheric pressure) A pump of this capacity is available through the Carrier Service Parts, CTD P/N 07-00176-01.

2. **Thermistor Vacuum Gauge –** A thermistor vacuum gauge (electronic vacuum gauge) measures the low absolute pressures necessary to remove moisture from the system. *A compound gauge (manifold gauge set) is not recommended because of it's inherent inaccuracy.* A vacuum gauge is available from a refrigeration supplier.

3. **Evacuation Hoses –** Three 3/8" evacuation hoses, the length to be determined by the application of the service set-up. 3/8 to 1/4 adapter connector are also needed to make compressor connections. (Evacuation hoses and adapters are available from your local refrigeration supplier.) Do not use standard refrigeration hoses to evacuate. These standard hoses are designed for pressure not vacuum and may collapse during evacuation.

4. **Recovery System –** A refrigerant recovery system is recommended for removing the refrigerant.

5. **Evacuation Manifold –** A evacuation manifold is recommended for connecting the equipment needed for a proper evacuation. The evacuation manifold can be made easily as shown in Figure 4-3.

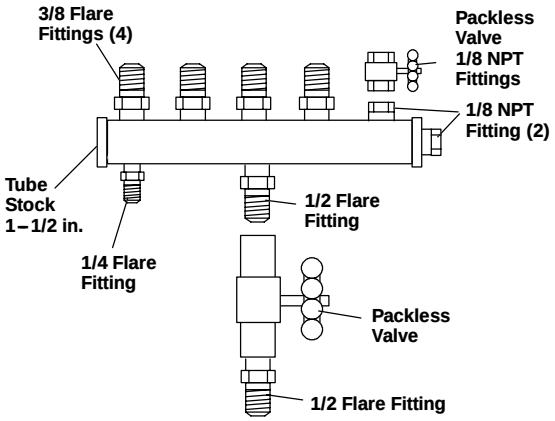


Figure 4-3. Evacuation Manifold

b. Evacuation Procedure

NOTE

When a low side pump down has been performed and after the low side has been evacuated the filter-dryer inlet valve needs to be opened. Also the liquid line solenoid valve needs to be manually energized.

To help speed up the evacuation process and to increase the evaporation of moisture, keep the ambient temperature above 60_F (15.6_C). If ambient temperature is lower than 60_F (15.6_C), ice may form before moisture removal is complete. Heat lamps or alternate sources of heat may be used to raise system temperature if necessary.

1. Before refrigerant removal and evacuation, leak test unit.

2. Remove all remaining refrigerant charge in the system.

3. Connect evacuation manifold, vacuum pump, vacuum gauge, reclaimer and hoses as shown in Figure 4-4. All hand valves on manifold should be closed. The compressor service valves should be midseated if used. The reclaimer valve should be closed.

4. Start vacuum pump. Slowly open manifold valve to the pump. Open valve to the vacuum gauge.

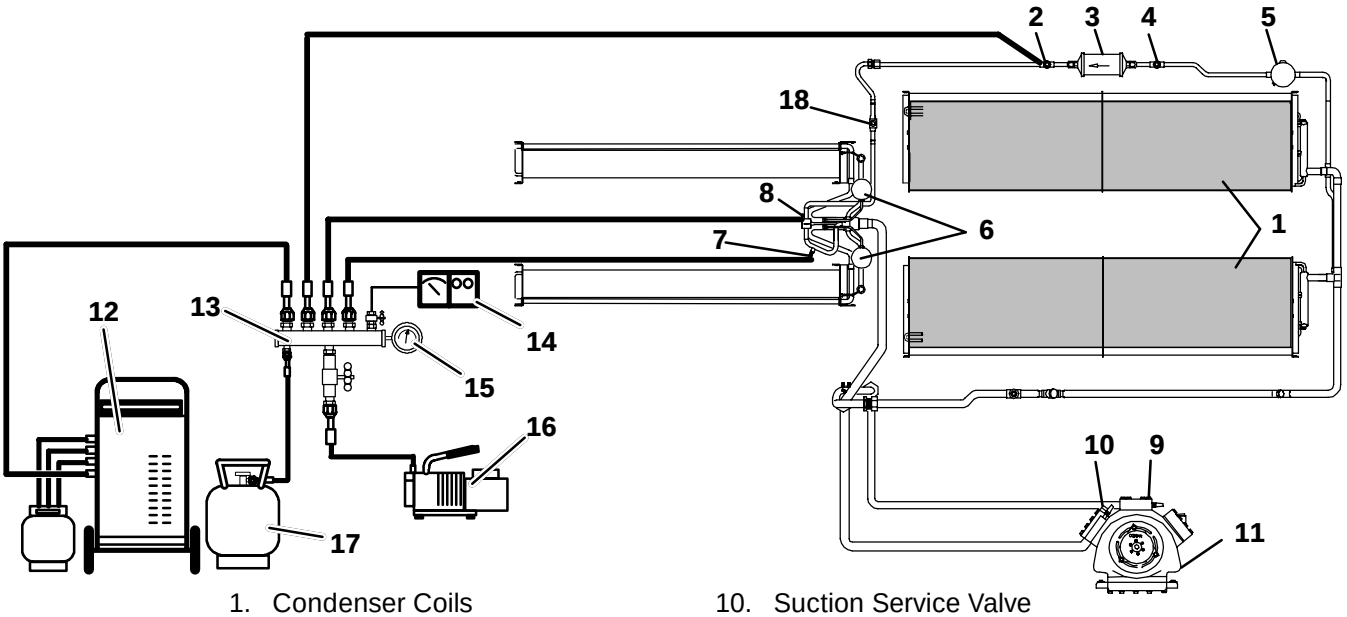
5. To open the liquid line solenoid valve, remove LLS-TB10 wire and supply 24 volts. Evacuate unit until vacuum gauge indicates 1500 microns (29.86 inches = 75.8 cm) Hg vacuum. Close gauge valve, vacuum pump valve, and stop vacuum pump.

6. Open the refrigerant cylinder vapor valve to break the vacuum. Raise the pressure approximately 2 psig. This will absorb any remaining moisture in the system for the second evacuation. Close the cylinder valve.

7. Repeat steps 4 and 5.

8. Evacuate again as described in step 3 to 300–500 microns Hg vacuum.

9. Charge the system to specifications through the refrigerant recovery machine (using manufactures charging procedure) or as outlined in the following section 4.8 (Charging the Refrigeration System).



1. Condenser Coils
2. Filter-Drier Outlet Service Valve
3. Filter-Drier
4. Filter-Drier Inlet Service Valve
5. Receiver
6. Thermostatic Expansion Valves
7. High Pressure Service Port
8. Low Pressure Service Port
9. Discharge Service Valve
10. Suction Service Valve
11. Compressor
12. Reclaimer
13. Vacuum Manifold
14. Thermistor Vacuum Gauge
15. Compound Gauge
16. Vacuum Pump
17. Refrigerant Cylinder
18. Liquid Line Solenoid Valve

Figure 4-4. Evacuation Set-Up

4.8 ADDING REFRIGERANT TO SYSTEM

a. Installing a Full Charge

1. Install a manifold gauge set as outlined in section Figure 4-3.

2. Evacuate and dehydrate the system as outlined in section 4.7 if not completed at this time.

3. Place the appropriate refrigerant cylinder (for R-134a) on the scale and connect charging line from the cylinder to the filter-drier inlet valve. Purge charging line at valve.

4. Note weight of refrigerant cylinder.

5. Open liquid valve on refrigerant cylinder. Open filter-drier inlet valve half way and allow the liquid refrigerant to flow into the unit. Monitor weight of refrigerant cylinder to determine how much refrigerant is entering the system. The correct charge is 16 lbs.

6. When refrigerant cylinder weight (scale) indicates that the correct charge has been added, close liquid line valve at the cylinder and backseat the filter-drier inlet valve. Disconnect lines. Check refrigerant charge.

If the entire charge cannot be added, a partial charge may be necessary.

b. Adding a Partial Charge

1. Start the vehicle engine and allow unit to stabilize.

2. Place the appropriate refrigerant container (for R-134a) on the scale and connect charging hose from refrigerant cylinder vapor valve to the compressor suction service valve or the drop tube service port. Purge charging line.

3. Open the refrigerant cylinder vapor valve. Midseat suction valve (if used) and monitor the weight of the cylinder to add the remaining refrigerant. Disconnect cylinder.

4.9 CHECKING REFRIGERANT CHARGE

The following conditions must be met to accurately check the refrigerant charge.

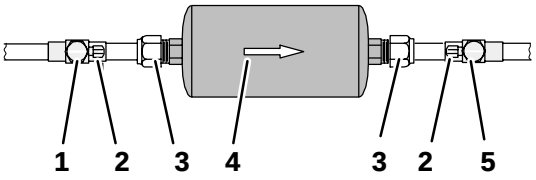
1. Bus engine operating at high idle.
2. Unit operation in cool mode for 15 minutes.
3. Head pressure at least 150 psig for R-134a systems.
   (It may be necessary to block condenser air flow to raise head pressure.)

a. Under the above conditions, the system is properly charged when the bottom receiver sight glass appears half full with refrigerant. If the bottom sight glass is not half full, add or remove refrigerant charge to the proper level.

4.10 FILTER-DRIER REMOVAL

If the sight glass on the receiver appears to be flashing or excessive bubbles are constantly moving through the sight glass, the unit may have a low refrigerant charge, or the filter-drier could be partially plugged.

If a pressure drop across the filter-drier is indicated or the moisture-indicator may show an abnormal (wet) condition, the filter-drier must be changed.



1. Filter-Drier Inlet Valve
2. Valve Service Port
3. Flare Nut
4. Filter-Drier
5. Filter-Drier Outlet Valve

Figure 4-5. Filter Drier Removal

a. Check for a restricted filter. Backseat the inlet and outlet valves of the filter-drier and attach the gauge manifold set. Midseat both valve and start unit. Observe the pressure reading. If a pressure drop of more than 10 psig is indicated the filter is plugged and must be changed.

b. Pump down the system as outlined in section 4.4.

c. Turn the driver's A/C switch and run control switch the "OFF" position.

d. Place a new filter-drier near the unit for immediate installation.

e. Using two open end wrenches, slowly crack open the flare nuts on each side of the filter-drier. After remaining refrigerant has escaped, remove the filter-drier.

CAUTION

The filter-drier may contain liquid refrigerant. Slowly open the flare nuts and avoid contact with exposed skin or eyes.

f. Remove seal caps from the new filter-drier. Apply a light coat of compressor oil to the flares.

g. Assemble the new filter-drier to lines ensuring that the arrow on the body of the filter-drier points in the direction of the refrigerant flow (refrigerant flows from right to left as viewed). Finger tighten flare nuts.

h. Tighten filter-drier inlet line flare nut using two open end wrenches.

i. Open the filter-drier inlet valve slowly to purge the filter-drier momentarily. Tighten the outlet flare nut using two open end wrenches.

j. Immediately backseat (fully close both service valve ports and replace valve caps.

k. Test filter-drier for leaks.

l. Check refrigerant level.

4.11 CHECKING PRESSURE SWITCHES

The recommended procedure for testing the High Pressure Switch (HPS), Low Pressure Switch (LPS), Condenser Fan Speed Switch (CFS), and Unloader Pressure Switch #2 (UPS2) is to remove the the switch from the unit and bench test as described in the following procedure.

All pressure switches are threaded into positive shut off connections (schrader) to allow easy removal and installation without pumping down or removing refrigerant from the unit. All wire leads to the switches are quick disconnects.

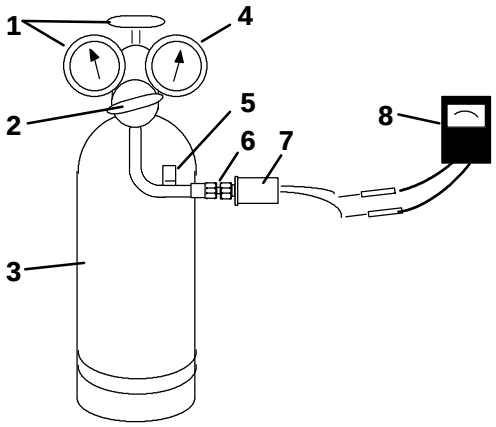
The High Pressure switch (black wire leads) and Low Pressure switch (red wire leads) are located on the compressor. The Condenser Fan Speed Switch (gray wire leads) is located on the discharge line near the roadside evaporator fan blower assembly. (See Figure 1-1.) The Unloader Pressure switch #2 (tan wire leads) is located on the suction line near the roadside evaporator fan blower assembly. (See Figure 1-1.)

If the switch does not function as described below, the switch is defective and should be replaced.

a. Remove switch from the unit.

b. Connect an ohmmeter across switch leads (with no pressure applied to the switch). A continuity reading should indicate a closed switch. If the switch is good, continue.

c. Connect switch to a cylinder of dry nitrogen as shown in Figure 4-6.



1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge (0 to 500 psig = 0 to 36 kg/cm@)
5. Bleed-Off Valve
6. 1/4 inch Connection
7. High or Low Pressure Switch
8. Ohmmeter

Figure 4-6. Checking High Pressure Switch

WARNING

Do not use a nitrogen cylinder without a pressure regulator. Cylinder pressure is approximately 2350 psi (165 kg/cm@). Do not use oxygen in or near a refrigeration system as an explosion may occur.

d. Back-off regulator adjustment completely. Open the cylinder valve.

e. Slowly open the regulator valve to increase the pressure to the applicable pressures listed in Table 4-1 to open or close the switch. If the ohmmeter reading does not correspond with the pressure listed in Table 4-1, the switch is defective and should be replaced.

f. Close cylinder valve and release the pressure through the bleed-off valve. As the pressure drops, the applicable switch will open or close. If the ohmmeter reading does not correspond with the pressure listed in Table 4-1, the switch is defective and should be replaced.

Table 4-1. Pressure Switch Continuity Check

Switch	Ohmmeter Reading	
	No Continuity-Switch Opens at:	Continuity-Switch Closes at:
High Pressure (HPS)	425 ± 10 psig	300 ± 10 psig
Low Pressure (LPS)	10 ± 3 psig	25 ± 3 psig
Cond. Fan Speed (CFS)	250 ± 15 psig	190 ± 15 psig
Unloader Press. #2 (UPS)	40 ± 5 psig	23 ± 3 psig

4.12 THERMOSTATIC EXPANSION VALVE

The thermal expansion valve is an automatic device which maintains constant superheat of the refrigerant gas leaving the evaporator regardless of suction pressure. The valve functions are: (a) automatic response of refrigerant flow to match the evaporator load and (b) prevention of liquid refrigerant entering the compressor. Unless the valve is defective, it seldom requires any maintenance.

a. Replacing the Expansion Valve

1. Pump down the unit. (Refer to section 4.4)

2. Remove left return air access panel.

3. Remove insulation (Presstite) from expansion valve bulb and remove from suction line.

4. Loosen flare nut and disconnect equalizer line from expansion valve.

5. Remove flange screws and lift off power head and cage assemblies. Check for foreign material in valve body.

6. Install new gaskets and assemble new cage and power head assemblies.

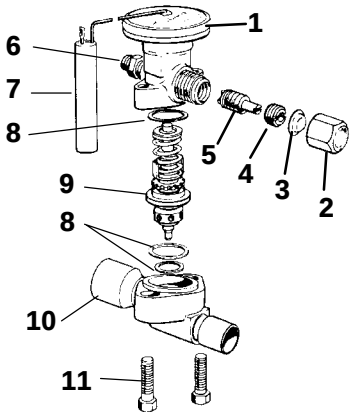
7. Attach the sensor bulb just below center of the suction line (4 or 7 o'clock position viewing from cross section to the suction line, see Figure 4-8). This area must be clean to ensure positive bulb contact. Do not insulate the bulb until the superheat is measured.

8. Fasten equalizer tube to expansion valve.

9. Evacuate by placing vacuum pump on the compressor suction service valve port or suction drop tube port (located in the engine compartment).

10. Open the inlet service valve to the filter-drier. Check refrigerant level. (Refer to paragraph 4.5.)

11. Check superheat.



1. Power Head
2. Cap Seal
3. Flare Seal
4. Retaining Nut
5. Adjusting Stem
6. Equalizer Connection
7. Sensor Bulb
8 Gasket
9. Cage Assembly
10. Body Flange
11. Capscrew

Figure 4-7. Thermostatic Expansion Valve

b. To Measure Superheat

NOTE

When conducting this test the suction pressure must be at least 6 psig (.42 kg/cm@) below the expansion valve maximum operating pressure (MOP). Refer to section 1.2.d for applicable valve settings.

1. Remove insulation from sensor bulb and suction line if installed..

2. Loosen one bulb clamp and make sure area under clamp is clean.

3. Place the temperature thermocouple above (parallel) TXV bulb and tighten loosened clamp making sure both bulbs are firmly secured to suction line as shown in Figure 4-8. Place insulation around TXV bulb and thermocouple.

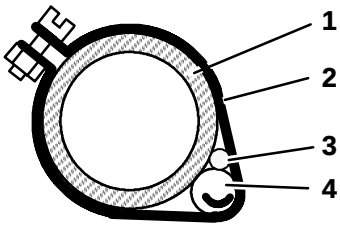
4. Connect suction gauge to the service port located on the suction line near the valve.

5. Set temperature controller to it's coolest setting. Run unit for at least 20 minutes to stabilize the system

6. Using the temperature/pressure chart (Table 4-2 or Table 4-3) for the applicable refrigerant used, determine the saturation temperature corresponding to the pressure taken at the suction service valve.

7. Note the temperature of the suction gas at the sensor bulb.

8. Subtract the saturation temperature determined in Step 6 from the average temperature measured in Step 7. The difference is the superheat of the suction gas.



1. Suction Line (end view)
2. Clamp
3. Thermocouple
4. TXV Sensor Bulb

Figure 4-8. Thermostatic Expansion Valve Bulb and Thermocouple

c. Adjusting Superheat

Refer to section 1.2.c for the superheat setting.

The thermostatic expansion valve used in this application is externally adjustable. The valve is preset at the factory and should not be adjusted unnecessarily. If necessary to adjust the superheat, proceed as follows:

1. Remove the seal cap to gain access to the superheat adjusting stem (see Figure 4-7).

2. Turn the adjusting stem clockwise to compress the valve spring which will decrease refrigerant flow through the valve, increasing superheat. Turn the adjusting stem counterclockwise to decompress the valve spring which will increase refrigerant flow through the valve, decreasing superheat.

3. When the unit has stabilized operation for at least 20 minutes, recheck superheat setting.

4. If superheat setting is correct, replace stem cap, remove gauge and thermocouple. Insulate bulb and suction line.

4.13 REMOVING THE HEATER COIL

a. Place the run control switch in the "OFF" position.

b. Open the air vent fitting at the top of the outlet header of the heater coil to bleed.

c. Drain coil by removing enough coolant from vehicle cooling system.

d. Disconnect water line from the coil.

CAUTION

If unit was recently operating, be careful of remaining hot coolant in the hoses when disassembling.

e. Remove coil retaining bolts on each side of the coil assembly (two each side). Pull top of coil assembly up and out to remove from unit.

f. Reverse procedure for installing new heater coil assembly.

4.14 REPLACEMENT OF EVAPORATOR COIL

a. If refrigerant remains in the system, perform a low side pump down, removing all refrigerant from the evaporator coils.

b. Using a 1/4'' allen wrench, remove the three allen head bolts (1 bolt on the back end, and 2 on the front end)securing the heater coil to the evaporator coil that is to be removed.

c. Remove the TXV power head assembly and the TXV support bracket from the body of the TXV.

d. Remove the two bolts on the back end of the evaporate coil, securing the evaporator coil. to the evaporate sub-frame. From the inside of the coach, reaching up through return air opening, remove the two bolts at the front end of the evaporator coil securing it to the sub-frame.

e. The panel covering the evaporate coil needs to be removed by loosening the phillips head screws along the overlapped edge of the control panel.

f. The brazed inlet and outlet lines need to be unsolder, but caution must be taken with the flame of the brazing torch so that no damage is done to the unit's fiberglass shell.

g. Once the inlet and outlet lines are loose the evaporate coil can be lifted up and out of the unit.

h. To install replacement evaporate coil reverse the above procedure.

4.15 SERVICING THE REHEAT COOLANT VALVE

The coolant valve requires no maintenance unless a malfunction to the internal parts or coil occurs. This may be caused by foreign material such as: dirt, scale, or sludge in the coolant system, or improper voltage to the coil.

To service the valve includes replacement of the internal parts shown in Figure 4-9 or the entire valve.

There are only three possible valve malfunctions: coil burnout, failure to open, or failure to close.

Coil burnout may be caused by the following:

1. Improper voltage.

2. Continuous over-voltage, more than 10% or Under-voltage of more than 15%.

3. Incomplete magnetic circuit due to the omission of the coil housing or plunger.

4. Mechanical interference with movement of plunger which may be caused by a deformed enclosing tube.

Failure to open may be caused by the following:

1. Coil burned out or an open circuit to coil connections.

2. Improper voltage.

3. Torn diaphragm.

4. Defective plunger or deformed valve body assembly.

Failure to close may be caused by the following:

1. Defective plunger or deformed valve body assembly.

2. Foreign material in the valve.

a. To replace a burnout coil, it is not necessary to drain the coolant from the system.

1. Place the run control switch in the "OFF" position.

2. Disconnect wire leads to coil.

3. Remove coil retaining screw and nameplate.

4. Lift burned-out coil from enclosing coil assembly and replace.

5. Connect wire leads and test operation.

b. To replace the internal parts of the valve:

1. Place the run control switch in the "OFF" position.

2. Open the vent fitting at the top of the outlet header of the heater coil.

3. Drain coil by removing enough coolant from vehicle cooling system.

4. Disassemble valve and replace defective parts.

5. Assemble valve and connect coolant hoses.

c. To replace the entire valve:

1. Drain coolant system and disconnect lines to valve as previously described.

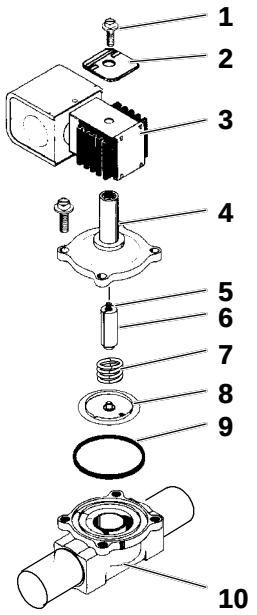
2. Disconnect wire leads to coil.

3. Remove valve assembly from bracket.

4. Install new valve and re-connect lines. It is not necessary to disassembly the valve when installing.

5. Fill system with coolant and bleed air through the vent fitting.

6. Connect wire leads and test operation.



1. Coil Retaining Screw
2. Nameplate
3. Coil Housing Assembly
4. Enclosing Tube & Bonnett Assembly
5. Kick-Off Spring
6. Plunger
7. Closing Spring
8. Diaphragm
9. O-Ring
10. Valve Body

Figure 4-9. Reheat Coolant Valve Assembly

4.16 SERVICING THE LIQUID LINE SOLENOID VALVE

The Liquid line solenoid valve is very similar to the coolant valve. It requires no maintenance unless a malfunction to the internal parts or coil occurs. This may be caused by foreign material such as: dirt, scale, or sludge in the refrigeration system, or improper voltage to the coil.

To service the valve includes replacement of the internal parts shown in Figure 4-10 or the entire valve.

There are only three possible valve malfunctions: coil burnout, failure to open, or failure to close. Coil burnout may be caused by the following:

1. Improper voltage.

2. Continuous over-voltage, more than 10% or under-voltage of more than 15%.

3. Incomplete magnet circuit due to the omission of the coil hosing or plunger.

4. Mechanical interface with movement of plunger which may be caused by a deformed enclosing tube.

Failure to open may be caused by the following:

1. Coil burned out or an open circuit to coil connections.

2. Improper voltage.

3. Torn diaphragm.

4. Defective plunger or deformed valve body assembly.

Failure to close may be caused by the following:

1. Defective plunger or deformed valve body assembly.

2. Foreign material in the valve.

a. To replace a burnout coil, it is not necessary to remove the refrigerant charge from the system.

1. Place the run control switch in the "OFF" position.

2. Disconnect wire leads to coil.

3. Remove coil retaining clip and nameplate.

4. Lift burned-out coil from enclosing coil assembly and replace.

5. Connect wire leads and test operation

b. To replace the internal parts of the valves

1. Place the run control switch in the "OFF" position.

2. Perform a low side pump down.

3. Disassemble valve and replace defective parts.

4. Assemble valve and leak check under valve while under pressure.

c. To replace the entire valve:

1. Perform a low side pump down and remove the lines to valve body.

2. Remove valve assembly from bracket.

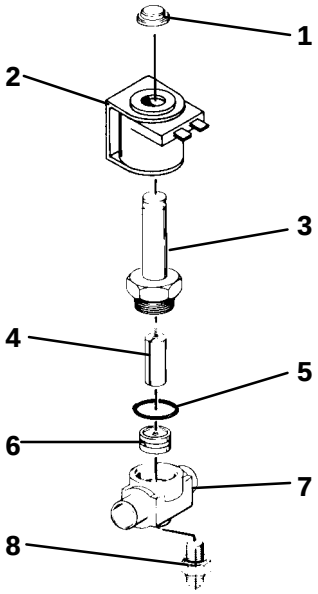
3. Disconnect wire leads to coil.

4. Install new valve and re-connect lines. It's necessary to disassembly the valve when soldering lines.

5. Leak check valve while under pressure.

6. Evacuate and charge system

7. Connect wire leads and test operation.



1. Snap Cap
2. Coil Assembly
3. Enclosing Tube Assembly
4. Plunger Assembly
5. Gasket
6. Piston Assembly
7. Body
8. Bracket Adapter

Figure 4-10. Liquid Line Solenoid Valve - Alco

4.17 REMOVING THE CONDENSER FAN MOTOR

a. Place run control switch to the OFF position.

b. Remove fan blade guard.

c. Remove the four motor mounting bolts from the bracket.

d. Disconnect motor wire harness and remove the motor by lifting the motor up and out.

e. To reassemble, reverse the above procedure.

4.18 SERVICING THE EVAPORATOR FAN BLOWER MOTOR ASSEMBLY

a. Removing and Disassembling

1. Place run control switch to the OFF position.

2. Disconnect the wire leads to the motor. Mark the leads for proper reassembly.

3. Remove motor mounting nuts from the bottom mounting studs.

4. From inside of the bus, remove the 8 bolts from each blower housing.

5. Also from inside of bus loosen the two blower hub set screws to remove blower. To do this a long handle 5/32" allen wrench is needed to reach blower hub through housing opening.

6. Slide loose housing off to side and then motor can be slid to side and lifted up to remove.

7. To reassemble, reverse the above procedure. Position blower in the center of the blower housing.

b. Routine Examination and Cleaning

1. At regular maintenance periods, remove brush covers and clean and examine motor interior.

2. Remove all foreign material, such as dirt and carbon dust with dry moderately compressed air. Clean by suction if possible to avoid blowing foreign matter into the motor.

3. Confirm free moving brushes to prevent binding.

4. Observe the condition of the commutator and the armature coils that are visible.

4.19 REPLACING THE RETURN AIR FILTERS

The return air filters are located in the return air opening inside the bus.

The filters should be checked for cleanliness periodically depending on operating conditions . A dirty air filter will restrict the air flow over the evaporator coil. This could cause insufficient cooling or heat and possible frost build up on the coil.

Remove filters as follows:

a. Remove the return air grille.

b. Turn the run control switch to OFF.

c. Loosen the filter retaining clips.

d. Remove the filter from the return air grille.

e. Reverse the procedure for installing the new filters.

4.20 COMPRESSOR

4.20.1 Replacing the Compressor

a. Removing

1. If compressor is inoperative and refrigerant pressure still exists, frontseat the suction and discharge service valves to isolate most of the refrigerant in the system from the compressor.

If the compressor runs, pump down the compressor by front seating the suction service valve until the pressure drops to 1 psig, then stop the unit.

2. Slowly release compressor pressure to a recovery system.

3. Remove the suction and discharge service valves and disconnect the high and low pressure switches (HPS & LPS).

4. Loosen the compressor to allow removal of all belts from the compressor.

5. Disconnect the wire connections to the unloader.

6. Attach sling or other device to compressor to remove. The compressor weighs approximately 146 lbs.

7. Remove the clutch from the compressor.

NOTE

If the compressor is to be returned to the factory, drain oil from defective compressor before shipping.

b. Installing

NOTES

1. It is important to check the compressor oil level of the new compressor and fill if necessary.

2. The service replacement compressor is sold without shutoff valves (but with valve pads). These should be placed on the old compressor before shipping. Check oil level in service replacement compressor. If none add the applicable amount outlined in section 1.2.b.

1. The original unloader valve must be transferred to the replacement compressor. The plug arrangement removed from the replacement is installed in the original compressor as a seal. If piston is stuck, it may be extracted by threading a socket head cap screw into top of piston. A small Teflon seat ring at bottom of piston must be removed.

2. Remove the high pressure switch and install on new compressor after checking switch setting (refer to section 4.11).

3. Install compressor in unit by reversing step 4.20.c. It is recommended using new locknuts when replacing compressor. Install new gaskets on service valves and tighten bolts uniformly.

4. Attach two lines (with hand valves near vacuum pump) to the suction and discharge service valves. Dehydrate and evacuate compressor to 500 microns (29.90" Hg vacuum = 75.9 cm Hg vacuum). Turn off valves on both lines to pump.

5. Fully backseat (open) both suction and discharge service valves.

6. Remove vacuum pump lines and install manifold gauges.

7. Start unit and check for noncondensibles

8. Check refrigerant level and add if necessary.

9. Check compressor oil level (refer to section 4.20.2). Add oil if necessary.

10. Check compressor unloader operation.

11. Check refrigerant cycles.

4.20.2 Checking the Compressor Oil Level

a. Operate the unit in high idle cooling for at least 20 minutes.

b. Check the oil sight glass on the compressor to ensure that no foaming of the oil is present after 20 minutes of operation. If the oil is foaming excessively after 20 minutes of operation, check the refrigerant system for flood-back of liquid refrigerant. Correct this situation before adding oil.

c. Check the level of the oil in the sight glass with the compressor operating. The correct level should be between 1/4 and 1/2 of the sight glass. If the level is above 1/2, oil must be removed from the compressor. If the level is below 1/8, add oil to the compressor as outlined in the following section.

4.20.3 Adding Oil to the Installed Compressor

CAUTION

The appropriate compressor oil must be used according to the refrigerant used in the system. (Refer to section 1.2.b.)

Two methods for adding oil are the oil pump method and closed system method.

a. Oil Pump Method

1. Connect an oil pump to a one U.S. gallon (3.785 liters) refrigeration oil container. Using the Robinair compressor oil pump (Carrier Transicold P/N 14388) is recommended.

When the compressor is in operation, the pump check valve prevents the loss of refrigerant, while allowing servicemen to develop sufficient pressure to overcome the operating suction pressure to add oil as necessary.

2. Backseat suction service valve and connect oil charging hose to port. Crack the service valve and purge the oil hose at oil pump. Add oil as necessary.

b. Closed System Method

In an emergency where an oil pump is not available, oil may be drawn into the compressor through the suction service valve.

CAUTION

Extreme care must be taken to ensure the manifold common connection remains immersed in oil at all times. Otherwise air and moisture will be drawn into the compressor.

1. Connect manifold gauge set. Place center charging line into compressor oil container as shown in Figure 4-11. Slowly open discharge hand valve to purge line, then close.

2. Frontseat the suction service valve and place a jumper wire on the low pressure switch to by-pass the switch.

3. Start unit and pull crankcase pressure until suction pressure gauge indicates 5 inches/hg. Shut down unit.

4. Crack open manifold valve and allow vacuum in compressor to draw oil slowly into compressor. When level is just above one quarter glass, close manifold valve. Midseat the suction service valve. Remove the LPS jumper wire.

5. Start unit and check compressor oil level.

6. Backseat valve to remove hose from suction service valve and replace service valve caps.

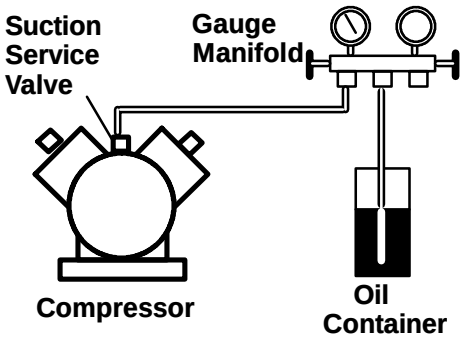


Figure 4-11. Compressor Oil Charge Connections

4.20.4 Adding Oil to Service Replacement Compressor

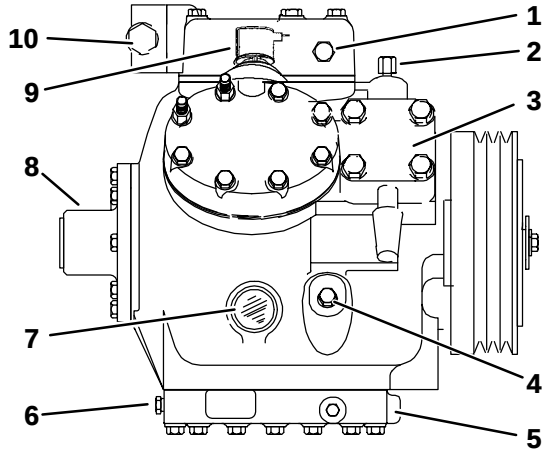
CAUTION

The appropriate compressor oil must be used according to the refrigerant used in the system. (Refer to section 1.2.b.)

Service replacement compressors may or may not be shipped with oil.

If compressor is without oil:

Add oil, (paragraph 4.20.2) through the suction service valve flange cavity or by removing the oil fill plug.



1. High Pressure Switch Connection
2. Low Pressure Switch Connection
3. Suction Service Valve
4. Oil Fill Plug
5. Bottom Plate
6. Oil Drain Plug
7. Oil Sight Glass
8. Oil Pump
9. Unloader Solenoid
10. Discharge Service Valve

Figure 4-12. Compressor - Model O5G

a. To Remove Oil From the Compressor

1. If the oil level recorded in paragraph 4.20.2 is above 1/2 of the sight glass, remove oil from the compressor. If at a full sight glass, remove 2-3/4 pints of oil from the compressor to lower the level to 1/2 of the sight glass.

2. Connect manifold gauges to the compressor.

3. Close suction service valve (frontseat) and pump unit down to 2 to 4 psig (1.4 to 2.8 kg/cm@). Frontseat discharge service valve and slowly bleed remaining refrigerant.

4. Remove the oil drain plug on the bottom plate of the compressor and drain the proper amount of oil from the compressor. Replace the plug securely back into the compressor.

5. Repeat paragraph a.1. to ensure proper oil level.

NOTE

Before opening up any part of the system, *a slight positive pressure should be indicated on both gauges.* If a vacuum is indicated, emit refrigerant by cracking receiver outlet valve momentarily to build up a slight positive pressure.

Table 4-2. R-134a Temperature–Pressure Chart

BOLD NO. = Inches Mercury Vacuum (cm Hg Vac)

Temperature		Pressure			Temperature		Pressure		
_F	_C	Psig	Kg/cm@	Bar	_F	_C	Psig	Kg/cm@	Bar
–40	–40	**14.6**	**37.08**	**0.49**	30	–1	26.1	1.84	1.80
–35	–37	**12.3**	**31.25**	**0.42**	32	0	27.8	1.95	1.92
–30	–34	**9.7**	**24.64**	**0.33**	34	1	29.6	2.08	2.04
–25	–32	**6.7**	**17.00**	**0.23**	36	2	31.3	2.20	2.16
–20	–29	**3.5**	**8.89**	**0.12**	38	3	33.2	2.33	2.29
–18	–28	**2.1**	**5.33**	**0.07**	40	4	35.1	2.47	2.42
–16	–27	**0.6**	**1.52**	**0.02**	45	7	40.1	2.82	2.76
–14	–26	0.4	0.03	0.03	50	10	45.5	3.20	3.14
–12	–24	1.2	0.08	0.08	55	13	51.2	3.60	3.53
–10	–23	2.0	0.14	0.14	60	16	57.4	4.04	3.96
–8	–22	2.9	0.20	0.20	65	18	64.1	4.51	4.42
–6	–21	3.7	0.26	0.26	70	21	71.1	5.00	4.90
–4	–20	4.6	0.32	0.32	75	24	78.7	5.53	5.43
–2	–19	5.6	0.39	0.39	80	27	86.7	6.10	5.98
0	–18	6.5	0.46	0.45	85	29	95.3	6.70	6.57
2	–17	7.6	0.53	0.52	90	32	104.3	7.33	7.19
4	–16	8.6	0.60	0.59	95	35	114.0	8.01	7.86
6	–14	9.7	0.68	0.67	100	38	124.2	8.73	8.56
8	–13	10.8	0.76	0.74	105	41	135.0	9.49	9.31
10	–12	12.0	0.84	0.83	110	43	146.4	10.29	10.09
12	–11	13.2	0.93	0.91	115	46	158.4	11.14	10.92
14	–10	14.5	1.02	1.00	120	49	171.2	12.04	11.80
16	–9	15.8	1.11	1.09	125	52	184.6	12.98	12.73
18	–8	17.1	1.20	1.18	130	54	198.7	13.97	13.70
20	–7	18.5	1.30	1.28	135	57	213.6	15.02	14.73
22	–6	19.9	1.40	1.37	140	60	229.2	16.11	15.80
24	–4	21.4	1.50	1.48	145	63	245.6	17.27	16.93
26	–3	22.9	1.61	1.58	150	66	262.9	18.48	18.13
28	–2	24.5	1.72	1.69	155	68	281.1	19.76	19.37

SECTION 5

ELECTRICAL

5.1 INTRODUCTION

This section includes electrical wiring schematics for model 68RF50 for NEOPLAN-LA. The schematic shown in this section is for R-134a refrigerant systems.

LEGEND		
SYMBOL	DESCRIPTION	LOCATION
ACHM	A/C HOURMETER	C-6
ACS	A/C SWITCH (OFF-ON)	C-8
ACSR	A/C STOP RELAY (TIME DELAYED)	C-6, C-7
ACR1	A/C RELAY	A-7, C-8
BPM	BOOST PUMP MOTOR	D-6
BPR	BOOST PUMP RELAY	B-6, D-7
CB1	15A CIRCUIT BREAKER - MANUAL RESET	D-8
CB2	40A CIRCUIT BREAKER - MANUAL RESET	D-7
CB3	40A CIRCUIT BREAKER - MANUAL RESET	D-7
CB6	10A CIRCUIT BREAKER - MANUAL RESET	C-7
CB7	40A CIRCUIT BREAKER - MANUAL RESET	D-6
CB8	40A CIRCUIT BREAKER - MANUAL RESET	D-6
CB9	40A CIRCUIT BREAKER - MANUAL RESET	C-6
CFR1	CONDENSER FAN RELAY #1	A-6, D-7
CFS	CONDENSER FAN SPEED SWITCH (360 PSI)	A-6
CL	CLUTCH	C-6
CM1	CONDENSER FAN MOTOR #1	D-6
CM2	CONDENSER FAN MOTOR #2	D-6
CM3	CONDENSER FAN MOTOR #3	C-6
CR	CLUTCH RELAY	A-6, D-7
CSR	CONDENSER SPEED RELAY	A-6
CSR1	CONDENSER SPEED RELAY	D-7
D1-D10	DIODE	
EM1	EVAPORATOR FAN MOTOR #1	D-6
EM2	EVAPORATOR FAN MOTOR #2	D-6
EFR1	EVAPORATOR FAN RELAY #1	C-7, D-7
ESR1	EVAPORATOR SPEED RELAY	D-7, D-8
ESR2	EVAPORATOR SPEED RELAY	C-8, D-7
FR	FAULT RELAY	C-6, C-7
FTS	FROST SWITCH	A-7
HPS	HIGH PRESSURE SWITCH (425 PSI)	C-8
HR	HEAT RELAY	B-7, C-8
HR2	HEAT RELAY	A-7
LATH	LOW AMBIENT THERMOSTAT (OPTIONAL)	A-7
LLS	LIQUID LINE SOLENOID	C-6
LPS	LOW PRESSURE SWITCH	C-7
LVCO	LOW VOLTAGE CUT-OUT	A-6
POT	POTENTIOMETER (TEMP ADJUST.)	B-8
PTB1	POWER TERMINAL BLOCK	D-8
RCS1	REAR CONTROL SWITCH #1	C-8
RCS2	REAR CONTROL SWITCH #2	C-8
RCV	REHEAT COOLANT VALVE	B-6
REC1	RECTIFIER #1	C-6
REC2	RECTIFIER #2	C-8
RHCS	REHEAT/CYCLE SWITCH	A-7
TH	ELECTRONIC THERMOSTAT	B-7, B-8
UPS2	UNLOADER PRESSURE SWITCH #2	B-8
UV1	UNLOADER VALVE #1	B-7
UV2	UNLOADER VALVE #2	B-7

NOTE:		
TC	TERMINAL BLOCK C (ON CONTROL PANEL)	B-8, C-8
TB	TERMINAL BLOCK B (ON CONTROL PANEL)	

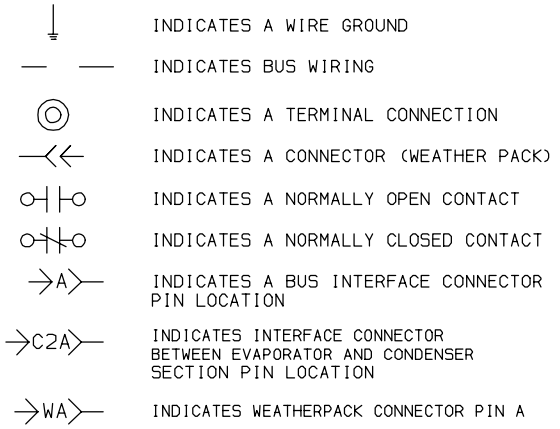

INDICATES A WIRE GROUND
INDICATES BUS WIRING
INDICATES A TERMINAL CONNECTION
INDICATES A CONNECTOR (WEATHER PACK)
INDICATES A NORMALLY OPEN CONTACT
INDICATES A NORMALLY CLOSED CONTACT
A
INDICATES A BUS INTERFACE CONNECTOR PIN LOCATION
C2A
INDICATES INTERFACE CONNECTOR BETWEEN EVAPORATOR AND CONDENSER SECTION PIN LOCATION
WA
INDICATES WEATHERPACK CONNECTOR PIN A

Figure 5-1. Electrical Wiring Schematic Diagram (68RF50 with Rotron Brushless Motors), Dwg. No. C-070-935, Rev C (Sheet 1 of 2)

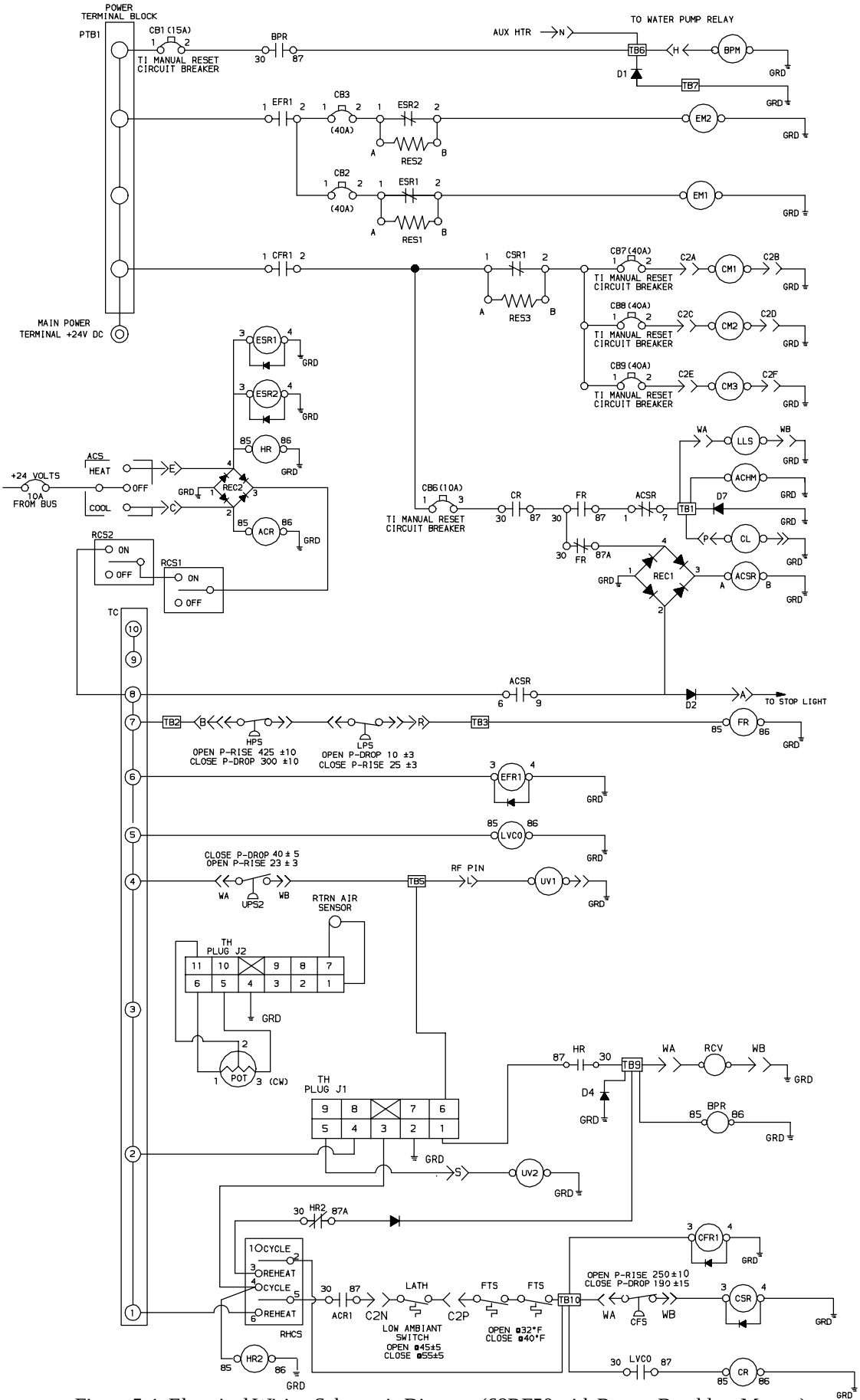


Figure 5-1. Electrical Wiring Schematic Diagram (68RF50 with Rotron Brushless Motors), Dwg. No. C-070-935, Rev C (Sheet 2 of 2)